FINAL

North Springs Improvement District

Task 4: Feasibility Level

Evaluation of Alternatives

NSID Pump Station 2 Photo Courtesy of South Florida Water Management District

Prepared by Ecology & Environment, Inc.

for South Florida Water Management District

March 11, 2004

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International Specialists in the Environment

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EXECUTIVE SUMMARY

A set of hydrologic and hydraulic models have been run using Interconnected Channel and Pond Routing Model – Version 3.0 to determine the feasibility of using an impoundment to the northeast of North Springs Improvement District (NSID) so that stormwater discharges during 10 year–24 hour, 25 year-72 hour and 100 year–72 hour storm events can be limited to 35 cubic feet per square mile (CSM) via NSID Pump Stations 1 and 2 (PS1 & PS2) to Hillsboro Canal and, at the same time, the stage heights do not exceed permit-approved elevations. The permit-approved maximum stage elevations are Road Crown Elevation during a 10 year-24 hour event (11.70 ft for the East basins and 10.7 for the West basins) and Building Floor Elevation during a 100 year-72 hour event (13.0 ft for the East basins and 12.2 for the West basins).

The model calculations show that the Bishop Property Rock Pit with a total area of 413 acres can be used as the storage basin. The stage-storage relationships for this impoundment indicate that when the stage height is 8 feet, the storage area is 356 acres. In this case, the combined discharge from the NSID PS1 and PS2 is restricted to 35 CSM. However, certain improvements to the conveyance structures occurring to the southeast of the NSID Basin are necessary in order to meet the stage elevation criteria at East Basin 1004 and West Basins 902 and 903. The conveyance structures that need improvements include P7, P9A, P9B, and P9C. The conveyance improvements include doubling the number of barrels in the culverts P7, P9A, and P9B (from 2 to 4) and adding one more barrel to the culvert P9C (from 2 to 3). In addition, the model uses a conveyance structure, consisting of eight 6-ft diameter 400-ft long barrels, that connects the Bishop Property Rock Pit as the storage area and NSID Basin 3101. For modeling purposes, excess discharge from the NSID Basin is evenly divided between the two pump stations. Each pump station discharges at a maximum rate of 204 cfs. Pumping at PS1 begins at a rate of 111.4 cfs when upstream stage elevation reaches 7.7 ft and is increased to 204 cfs when this elevation is 8.0 ft. Similarly, PS2 begins pumping at a rate of 111.4 cfs when

the upstream stage elevation reaches 7.85 ft and is increased to 204 cfs when this elevation is 8.0 ft.

The calculated amount of the total volume of discharge to the Hillsboro Canal during a 10 year-24 hour event is 803.5 acre-ft and that during a 100 year-72 hour event is 1769 acre-ft. The impact of this discharge on the water surface elevations within Hillsboro Canal needs to be evaluated using separate hydrologic and hydraulic models.

I. Introduction

On behalf of the South Florida Water Management District (SFWMD), Ecology & Environment, Inc. (E & E) has been tasked to conduct a feasibility level hydrologic and hydraulic (H&H) analysis for the North Springs Improvement District (NSID). Figure 1 shows the location of NSID.

The analysis is divided into five tasks. Initial work efforts included the refinement of an existing H&H model that had been developed for the NSID Basin. The results of this model refinement were summarized in a report submitted by E & E to the SFWMD in October of 2003. The present investigation (Task 4) involves a preliminary H&H evaluation of alternatives to maximize the storage of surface waters within the basin. The evaluation is limited to hydraulic feasibility. Other factors such as cost, implementation, permitting, site constraints, etc. that may affect feasibility will be addressed by others if the H&H analysis proves promising. This report summarizes the work efforts for the present H&H evaluation task, the results and conclusions.

II. Background

Florida's Everglades Forever Act (EFA), F. S. 373.4592 establishes the Everglades Protection Area (EPA) that includes Water Conservation Areas (WCAs) 1, 2A, 2B, 3A, 3B, the Arthur R. Marshall Loxahatchee National Wildlife Refuge, and the Everglades National Park. The EFA requires that SFWMD obtain a permit from the Florida Department of Environmental Protection (FDEP) to operate and maintain water control structures such as pumps, gates, and culverts which discharge water into, within, or from the EPA and which are not included in the Everglades Construction Project (ECP). The purpose of this permit is to establish limitations on discharge quantities with the objective to meet long-term water quality goals designed to restore and protect the EPA. The SFWMD obtained such a permit (#06, 502590709) from FDEP. This permit is designated as the Non-ECP Permit. Subsequent to the issuance of this permit, the SFWMD initiated the implementation of the permit conditions through the creation of Everglades Stormwater Program (ESP). The ESP includes eight basins. One of these eight ESP basins is the NSID Basin. The long-term goal of the Everglades restoration effort is to combine point source controls, basin-level solutions and regional solutions in a system-wide approach to ensure that all waters discharged into EPA meet the numeric phosphorous criterion and other applicable state water quality standards. In order to achieve this goal, the SFWMD has developed a Conceptual Plan for Achieving Long-term Water Quality Goals (Long-Term Plan) to ensure that all discharges from these basins to EPA meet the final water quality objectives.

There are two NSID pump stations (the north, PS2, and south, PS1, pump stations). Both pumps discharge water into the L-36 Canal which flows into the Hillsboro Canal to the north of the NSID Basin. NSID PS1 can also discharge water into WCA 2A. The NSID's surface water permit limits the discharges to the L-36 Canal when the capacity of the Hillsboro Canal is exceeded (reaches a specific elevation), and the excess NSID flows are discharged into WCA 2A via the NSID PS1. The long term plan for the NSID Basin recognizes that the conveyance of NSID flows to the Hillsboro Canal and the Hillsboro

Site 1 Impoundment or other storage is the most cost effective means of diverting all of NSID stormwater runoff away from WCA 2A. In order to ensure this plan, it is necessary that the excess flow that would have been discharged to WCA 2A to the Hillsboro Canal be minimized. The present investigation (Task 4) is aimed to evaluate the feasibility of storage of certain portions of the excess flow within an impoundment adjacent to the NSID Basin while the rest of the portions of the excess flow are pumped at certain rates to the Hillsboro Canal. A follow-up effort (Task 5) will review the impacts of this excess flow on the Hillsboro Canal.

III. Modeling Objectives and Criteria

There are two objectives of the present investigation that involves hydrologic and hydraulic (H&H) modeling of the NSID basins. The first purpose of the H&H modeling is to determine how much additional storage area north of NSID Basin is required so that the following criteria can be met:

- Combined discharge from NSID PS1 and PS2 is limited to 35 CSM
- From a 10 year-24 hour storm event, the stage is maintained at or below permit-approved minimum Road Crown Elevations (11.70′ for East Basin and 10.70′ for West Basin)
- From a 100 year-72 hour storm event, the stage is maintained at or below permit-approved minimum Building Floor Elevations (13.00′ for East Basin and 12.20′ for West Basin)

In the second objective of the investigation, the Bishop Property Rock Pit is considered as the storage (detention) area. In this case, H&H modeling is used to determine how much flow out of the NSID Basin in excess over 35 CSM is needed to achieve the following two conditions:

- From a 10 year-24 hour storm event, the stage is maintained at or below permit-approved minimum Road Crown Elevations (11.70′ for East Basin and 10.70′ for West Basin)
- From a 100 year-72 hour storm event, the stage is maintained at or below permit-approved minimum Building Floor Elevations (13.00′ for East Basin and 12.20′ for West Basin)

Meeting of the above-noted criteria within the Sawgrass group of basins is not part of the objectives of the modeling since the basins within the Sawgrass group are at elevations higher than the limiting stage heights for the two storm events used in the calculations.

All H&H models (previous and present) were and are being developed using the software called Interconnected Channel and Pond Routing Model – Version 3.0 (ICPR v.3) developed by Streamline Technologies, Inc.

IV. Base Model

The base H&H model of the NSID Basin is comprised of 43 sub-basins grouped into three groups, namely the East, West, and Sawgrass Basins (see Figure 2). The waterways within all of the sub-basins are linked (interconnected) predominantly by pipes (culverts) and, in some cases, with the aid of certain other hydraulic structures such as drop structures and weirs. As noted above, there are two NSID pump stations along the western margin of the NSID Basin. The north and south pump stations are designated as PS2 and PS1, respectively. In the base model, PS1 and PS2 begin pumping both at a rate of 50,000 gpm (111.4 cfs) when the upstream stage elevation reaches 7.70 and 7.85 ft, respectively, at PS1 and PS2. When the upstream stage elevation at PS2 reaches 8.0 ft, the pumping rate is increased to 100,000 gpm (222.8 cfs), and when the stage height at this station reaches 10 year-24 hour elevation (10.178 ft.) pumping is stopped. On the other hand, at PS1, pumping at a rate of 50,000 gpm continues until the upstream stage reaches an elevation of 10.221 ft (10 year-24 hour elevation). At this stage, pumping is increased to 200,000 gpm at PS1. The pumping operation has been modeled in this manner to simulate the actual pumping operation which is based on the principle that when the water stage/elevation in the L-36 Canal reaches the 10 year-24 hour elevation (assumed to be 10.221′ and 10.178′ at upstream of PS1 and PS2, respectively) pumping from the north pump station (PS2) stops and the south pump station (PS1) continues to pump at a rate of 200,000 gpm (445.6 cfs). For simulating these conditions, the Operating Tables in the ICPR model are set up as shown in Tables 1 and 2.

Table 1. Base Model Operating Table For The Pump Station (Link) PS1

Table Name: PS1 Group: OP_TABLES

Link Type: Rating Curve

Function: Upstream (US) Stage vs. Discharge

US Stage (ft)	Discharge (cfs)
0.000	0.00
7.699	0.00
7.700	111.40
10.221	111.40
10.221	445.60
20.000	445.60

Table 2. Base Model Operating Table For The Pump Station (Link) PS2

Table Name: PS2	Group: OP_TABLES
Link Type: Rating Curve	
Function: US Stage vs. Discharge	
US Stage (ft)	**Discharge (cfs)**
0.000	0.00
7.850	0.00
7.850	111.40
8.000	111.40
8.000	222.80
10.178	222.80
10.178	0.00
20.000	0.00

V. Feasibility Level Evaluations of Storage Alternatives

The base model discussed above has been modified to incorporate an additional storage area and changing pumping conditions. Initially, two subsets of models have been developed. In the first model, designated as Model FS1, a hypothetical storage area is used. In this model the total pumping capacity of the two pump stations is kept at a value of 35 CSM. In the second model, designated as FS2, the Bishop Property Rock Pit is used as the additional storage area. In this case, the area of the storage is fixed but the total pumping capacity of the two pump stations is allowed to exceed 35 CSM.

V.1. Model FS1

In this model, the hypothetical storage area (designated as Hstorage) is linked to sub-basin 3101 by a culvert with two circular barrels each 400 feet long and 6 feet in diameter. This conveyance structure is designated as 'Pstorage'. The stage-area relationships for the storage area were developed from the original plan and cross sectional drawing of the Bishop Property Rock Pit. The reason for using the 'footprint' of the Bishop Property Rock Pit is to create, if possible, a reservoir from the area that currently exists for potential availability. If the results showed an inability to meet the 35 CSM, then more storage would be provided until the 35 CSM and elevation criteria were met. The stage-area relationships for this reservoir for Model FS1 are given in Table 3.

Table 3. Model FS1 Stage-Area Relationships Of The Hypothetical Storage Area

Stage (ft)	Area (acre)
7.0	360.8
7.5	362.3
8.0	364.7
8.5	366.6
9.0	368.7
9.5	397.2
10.0	397.87
10.5	398.52
11.0	399.19
11.5	399.85
12.0	400.52
12.5	401.17

The maximum area assigned for this detention pond is 413 acres. Once this area is incorporated into the total existing area of NSID Basin (7046.2 acres) then the equivalent flow of 35 CSM is 408 cfs. Based on input from the SFWMD, the operating tables in the ICPR model are modified such that when the water stage/elevation in the L-36 Canal reaches the 10 year-24 hour elevation (assumed to be 10.221′ and 10.178′ at upstream of PS1 and PS2, respectively), two pumps in each of the pumping stations are turned on. Thus, each pump station pumps at a rate of 204 cfs such that the combined discharge is 408 cfs (35 CSM for an area of 7459.2 acres or 11.7 square mile). Each pump discharges at a rate of 45,769 gpm. The operating tables are presented in Tables 4 and 5.

Table 4. Model FS1 Operating Table For The Pump Station (Link) PS1

Table Name: PS1 Group: OP_TABLES

Link Type: Rating Curve

Function: Upstream (US) Stage vs. Discharge

US Stage (ft)	Discharge (cfs)
0.000	0.00
7.699	0.00
7.700	111.40
8.000	111.40
10.221	111.40
10.221	203.96
12.200	203.96
20.000	203.96

Table 5. Model FS1 Operating Table For The Pump Station (Link) PS2

Table Name: PS2 Group: OP_TABLES

Link Type: Rating Curve

Function: US Stage vs. Discharge

US Stage (ft)	Discharge (cfs)
0.000	0.00
7.850	0.00
7.850	111.40
8.000	111.40
10.178	111.40
10.178	203.96
12.200	203.96
20.000	203.96

Once these modifications were made, model runs were carried out using 10 year-24 hour and 100 year-72 hour rainfall events that had been built into the base model. The maximum stage height at each of the nodes was recorded.

V.2. Model FS2

In this model, the Bishop Property Rock Pit is used as the additional storage area (designated as Bishop Property) and is linked to sub-basin 3101 by a culvert with two circular barrels each 400 feet long and 6 feet in diameter. This conveyance structure is designated as 'PBishop'. The stage-area relationships for the storage area were developed from the original plan and cross sectional drawing of the Bishop Property Rock Pit after certain modifications for conservatism. The modifications are made such that at a stage elevation of 8 feet, the storage area is 350 acres. In order to achieve this, the side slopes in the present plan are changed from 2:1 to 1.5:1. This resulted into a slight increase in area (356.4 acres) at a stage elevation of 8.0 feet. The details of the calculation methods are given in Appendix A. The complete stage-area relationships are given in Table 6.

Table 6. Model FS2 Stage-Area Relationships Of The Bishop Property Rock Pit

Stage (ft)	Area (acre)
7.0	352.59
7.5	354.01
8.0	356.39
8.5	358.29
9.0	360.42
9.5	390.87
10.0	391.52
10.5	392.19
11.0	392.84
11.5	393.50
12.0	394.16
12.5	394.82

Thus, the maximum area assigned for this detention pond is also 413 acres but storage at stage elevation of 8 ft is 356.4 acres. The operating tables in the ICPR model are

modified such that the once the water stage/elevation in the L-36 Canal reaches the 10 year-24 hour elevation (assumed to be 10.221′ and 10.178′ at upstream of PS1 and PS2, respectively), two pumps in each of the pumping stations are turned on with each pump discharging at a rate of 50,000 gpm (the maximum discharge capacity of each pump is 50,000 gpm). Thus, each pump station pumps at a rate of 222.80 cfs such that the combined discharge is 445.6 cfs. This is equivalent to 38.31 CSM or 3.31 CSM excess over 35 CSM. The operating tables are presented in Tables 7 and 8.

Table 7. Model FS2 Operating Table For The Pump Station (Link) PS1

Table Name: PS1	Group: OP_TABLES
Link Type: Rating Curve	
Function: Upstream (US) Stage vs. Discharge	
US Stage (ft)	**Discharge (cfs)**
0.000	0.00
7.699	0.00
7.700	111.40
8.000	111.40
10.221	111.40
10.221	222.80
12.200	222.80
20.000	222.80

Table 8. Model FS2 Operating Table For The Pump Station (Link) PS2

Table Name: PS2	Group: OP_TABLES
Link Type: Rating Curve	
Function: US Stage vs. Discharge	
US Stage(ft)	**Discharge(cfs)**
0.000	0.00
7.850	0.00
7.850	111.40
8.000	111.40
10.178	111.40
10.178	222.80
12.200	222.80
20.000	222.80

VI. Model Results for Runs Without Modifications to the Conveyance Structures

The first set of runs without any modification to the conveyance structures show that there is one case of exceedance of the criteria in East Basin 1004 for the 10 year-24 hour storm and two such exceedances in West Basins 902 and 903. For the 100 year-72 hour storm there was one exceedance in West Basin 902 with Base Model and Model FS-1. These are the southeastern most basins that are farthest from the pump stations and storage reservoir. It is important to note that all the exceedances were minor and elevations were similar to that calculated for the base conditions. These exceedances of the criteria for the three models are summarized in Table 9. In all other nodes the criteria were satisfied.

Table 9. Results Of Calculations To Show Exceedances Of Criteria In The Three Models.

Basin/Group	Storm	(Stage in ft)		
		Base Model	FS-1	FS-2
1004/East	10Yr-24H	11.751	11.751	11.751
902/West	10Yr-24H	10.955	10.953	10.953
903/West	10Yr-24H	10.759	10.750	10.750
902/West	100Yr-72H	12.207	12.210	12.208

The stage-time graphs for the hypothetical storage area (HStorage) and Bishop Property calculated with Models FS-1 and FS-2 are shown in Figures 3 through 6, and Figure 2, respectively. Please note that SFWMD72 represents the 100 year – 72 hour storm event on all figures, and input and output data.

VII. Effects of Modifications to the Conveyance Structures

Subsequent to the developments of the two feasibility level models discussed above, a number of iterative runs were made. In this set of runs, changes in the diameter and number of barrels in a culvert were made for the conveyance structures P54 through P63 and Pstorage/Pbishop. All of these conveyance structures occur near the storage area. The purpose of this exercise was to test whether the criteria set forth above can be met at each of the nodes within the East and West Basins after introducing certain changes in the conveyance structures near the planned storage area. However, these runs with modifications to the conveyance structures showed negligible improvements in meeting the criteria at the nodes where exceedances were observed in the first set of feasibility level runs. To illustrate the point, the modifications that were incorporated in the pipe diameter (span) and the resulting improvements in calculated stage heights at two of the 'problem nodes' are noted in Table 10. Similarly, the modifications to the number of barrels and the resulting improvements in calculated stage heights at the same 'problem nodes' are noted in Table 11.

Table 10. Results Of Modified Pipe Diameter (near Storage Area) On Maximum Stage Heights At The Nodes Where Exceedances Of The Criteria Occur.

Iteration	Pipe Name	Inch		Max Stage (ft)	
		Original Span	Modified Span	1004	902
1-FS1	Pbishop	72	96	11.750	10.927
2-FS1	P54, P55	72	96	11.750	10.925
3-FS1	P54, P55	72	24	11.751	10.939
4-FS1	Pbishop	72	96		
	P57,P61,P62	72	84	11.751	10.939
5-FS1	Pbishop	72	24		
	P57,P61,P62	72	24	11.751	10.936
1-FS2	Pbishop	72	96	11.750	10.926
2-FS2	P54, P55	72	96	11.750	10.925
3-FS2	P54, P55	72	24	11.751	10.938
4-FS2	Pbishop	72	96		
	P57,P61,P62	72	84	11.750	10.926
5-FS2	Pbishop	72	24		
	P57,P61,P62	72	24	11.750	10.923

Table 11. Results Of Modified Pipe Counts (near Storage Area) On Maximum Stage At The Nodes Where Exceedances Of The Criteria Occur.

Trial	Pipe Name	Count		Max Stage (ft)		
		Original	Modified	1004	902	903
1-FS1	Pstorage	2	3	11.751	10.951	10.744
2-FS1	Pstorage	2	3			
	P54, P55	2	3	11.751	10.950	10.742
3-FS1	Pstorage	2	4			
	P54, P55	2	4	11.751	10.948	10.735
4-FS1	Pstorage	2	4			
	P57,P61,P62	2	4	11.751	10.935	10.719
5-FS1	Pstorage	2	4			
	P57,P61,P62	2	1	11.751	10.948	10.736
1-FS2	Pbishop	2	4	11.751	10.949	10.740
2-FS2	Pbishop	2	3			
	P54, P55	2	3	11.751	10.951	10.743
3-FS2	Pbishop	2	4			
	P54, P55	2	4	11.751	10.948	10.736
4-FS2	Pbishop	2	4			
	P57,P61,P62	2	4	11.751	10.950	10.742
5-FS2	Pbishop	2	4			
	P57,P61,P62	2	1	11.751	10.948	10.737

Since all exceedances occur to the southeastern portion of the NSID Basin it can be concluded that the effects of basin lag supercede the effects of modifications of the conveyance structures present in the northwestern part of the basin (near storage area). For this reason, another set of iterations was performed where modifications were made to the conveyance structures that connect the nodes where exceedances were observed (southeastern portion of the NSID Basin). These modifications result in meeting the criteria. The modifications and their effects on the maximum stage heights where exceedances occurred in previous runs are presented in Table 12. The results shown are based on a model run with all the changes to pipe nodes P7, 9A, 9B, and 9C.

Table 12. Results Of Modified Pipe Counts (in Exceedance Areas) On Maximum Stage At The Nodes Where Exceedances Of The Criteria Occur.

Bishop Property					
Pipe Name	**Count (No. of Pipes)**		**Max Stage (ft)**		**Nodes**
	Before	**After**	**Before**	**After**	
P7	1	2	11.751	11.641	1004/East
P9A	2	4	10.953	10.699	902/West
P9B	2	4	10.750	10.638	903/West
P9C	2	3	12.209	12.190	902/West (100Y)
Hypothetical Storage Area					
Pipe Name	**Count (No. of Pipes)**		**Max Stage (ft)**		**Nodes**
	Before	**After**	**Before**	**After**	
P7	1	2	11.751	11.641	1004/East
P9A	2	4	10.953	10.699	902/West
P9B	2	4	10.750	10.637	903/West
P9C	2	3	12.209	12.192	902/West (100Y)

VIII. The Final Model

From the feasibility level models, the iterative runs and input from the SFWMD and NSID representative, a final model was developed. In this model the following features have been incorporated.

- The Bishop Property Rock Pit is used as the storage area. Table 13 shows the stage-area relationship used in the final model.
- Total discharge is restricted to 35 CSM but increased pumping begins at both pump stations when the upstream stage elevation reaches 8.00 ft. The operating tables in the model are presented in Tables 14 and 15.
- Modifications to the conveyance structures P7, P9A, P9B, and P9C are made as presented in Table 12.
- In addition, eight counts (barrels) are used in the conveyance structure (culvert) 'PBishop', connecting 3101 basin with the Bishop Property storage basin.

Further details on the model inputs and outputs can be found in Appendices B and C.

Table 13. Final Model Stage-Area Relationships Of The Bishop Property Rock Pit

Stage (ft)	Area (acre)
7.0	352.59
7.5	354.01
8.0	356.39
8.5	358.29
9.0	360.42
9.5	390.87
10.0	391.52
10.5	392.19
11.0	392.84
11.5	393.50
12.0	394.16
12.5	394.82

Table 14. Final Model Operating Table For The Pump Station (Link) PS1

Table Name: PS1	Group: OP_TABLES
Link Type: Rating Curve	
Function: Upstream (US) Stage vs. Discharge	
US Stage (ft)	**Discharge (cfs)**
0.000	0.00
7.699	0.00
7.700	111.40
8.000	111.40
8.000	203.96
10.700	203.96
12.200	203.96
20.000	203.96

Table 15. Final Model Operating Table For The Pump Station (Link) PS2

Table Name: PS2	Group: OP_TABLES
Link Type: Rating Curve	
Function: US Stage vs. Discharge	
US Stage (ft)	**Discharge (cfs)**
0.000	0.00
7.850	0.00
7.850	111.40
8.000	111.40
8.000	203.96
10.700	203.96
12.200	203.96
20.000	203.96

The results of this final model show no exceedance of the criteria in any of the nodes of the East and West groups. When all of the conveyance structures (P7, P9A, P9B, and P9C) are modified according to the counts (number of barrels) shown in Table 12, the stage heights at the nodes where exceedances in previous runs were observed, are reduced as shown in Table 16. Further details comparing all to nodes for the Base Model to the Final Model for each of the storm events is included in Appendix D.

Table 16. Modified Stage Elevations At Nodes Where Exceedances Occurred As Result Of Conveyance Changes (P7, P9A, P9B, And P9C).

Nodes	Stage Elevation (with out conveyance modification)	Stage Elevation (with conveyance modification)
1004/East	11.751	11.641
902/West	10.953	10.667
903/West	10.750	10.585
902/West (100Yr)	12.209	12.157

In addition, the hydrologic response by basins 3101 and the Bishop Property storage basin become similar as shown in Figures 7 and 8. Figure 9 shows the inflow and outflow hydrographs for the Bishop Property storage area. For the period of simulation, the outflow from this storage area remains nearly zero. This indicates that the model calculations support the idea of using this as the storage (detention) basin during the extreme storm events. The changes in volumes of the storage area are shown in Figures 10, 11 and 12 for the 10-year, 25-year and 100-year events, respectively.

The pump station hydrographs are shown in Figures 13 and 14. Also, the information is summarized in Table 17 and includes all three storm events. These hydrographs enable one to calculate the total volume of discharge to the L-36 Canal (and hence to Hillsboro Canal) during the time period used in the model simulations. Figures 15, 16 and 17 show the volumes of water discharged to the OUTFALL, which is modeled as the final discharge point from entire NSID basin for the 10-Yr, 25-Yr, and 100-Yr events respectively. This volume of water will be discharged to Hillsboro Canal though conveyance by the L-36 Canal.

Table 17: Final Model Pump Station Hydrographs

Simulation	Link	Q cfs	Time Hrs
10Yr-24H	PS1	0	0
10Yr-24H	PS1	0	11.5
10Yr-24H	PS1	111.4	12.0
10Yr-24H	PS1	203.96	12.5
10Yr-24H	PS1	203.96	36.0
10Yr-24H	PS2	0	0
10Yr-24H	PS2	0	12.0
10Yr-24H	PS2	203.96	12.5
10Yr-24H	PS2	203.96	36.0
25YrSFWMD72	PS1	0	0
25YrSFWMD72	PS1	0	51
25YrSFWMD72	PS1	60.68	51.09
25YrSFWMD72	PS1	91.53	51.25
25YrSFWMD72	PS1	111.4	51.42
25YrSFWMD72	PS1	111.4	56.09
25YrSFWMD72	PS1	203.96	56.17
25YrSFWMD72	PS1	203.96	96.0
25YrSFWMD72	PS2	0	0
25YrSFWMD72	PS2	0	54.33
25YrSFWMD72	PS2	111.4	54.42
25YrSFWMD72	PS2	111.4	56.42
25YrSFWMD72	PS2	203.96	56.5
25YrSFWMD72	PS2	203.96	96.0
100YrSFWMD72	PS1	0	0
100YrSFWMD72	PS1	0	38.5
100YrSFWMD72	PS1	74.67	39.0
100YrSFWMD72	PS1	111.4	39.5
100YrSFWMD72	PS1	111.4	49.0
100YrSFWMD72	PS1	203.96	49.5
100YrSFWMD72	PS1	203.96	96.01
100YrSFWMD72	PS2	0	0
100YrSFWMD72	PS2	0	43.5
100YrSFWMD72	PS2	111.4	44
100YrSFWMD72	PS2	111.4	49.5
100YrSFWMD72	PS2	203.96	50
100YrSFWMD72	PS2	203.96	96.01

NOTE: SFWMD72 represents the 100 Year – 72 hour storm event on all figures, and input and output data

IX. Conclusions

The model calculations show that if Bishop Property Rock Pit is used as a storage area and certain improvements are made to the conveyance structures that connect the basins to the southeast of the NSID then 35 CSM can be pumped as a combined discharge from PS1 and PS2 and, at the same time, the permit-approved stage heights at each of the nodes of the East and West Basins can be satisfied under both 10 year-24 hour and 100 year-72 hour storm events. Table 17 provides the comparisons of the stage elevations at the nodes in the East and West Basins where criteria were exceeded in the Base Model with that in the Final Model for those two storm events. Further details comparing all nodes for the Base Model to the Final Model for the 10 year-24 hour, 25 year-72 hour and 100 year-72 hour storm events is included in Appendix D.

Table 18. Comparisons of the Stage Elevations At Nodes Where Exceedances Occurred under Base Model and Where the Criteria were Satisfied in the Final Model.

Nodes	Base Model	Final Model
1004/East	11.751	11.641
902/West	10.955	10.667
903/West	10.759	10.585
902/West (100Yr)	12.207	12.157

The pump station hydrographs indicate that for a 10 year-24 hour storm, the total volume of discharge to the L-36/Hillisboro Canals is 803.5 acre-ft. For a 25 year-72 hour storm event, the total volume of discharge is 1414 acre-ft whereas for a 100 year-72 hour storm event, the total volume of discharge is 1769 acre-ft.

The impact of these volumes of discharges to the Hillsboro Canal needs to be determined by a different set of H&H modeling.

Figures

Figure 1. North Springs Improvement District Basin

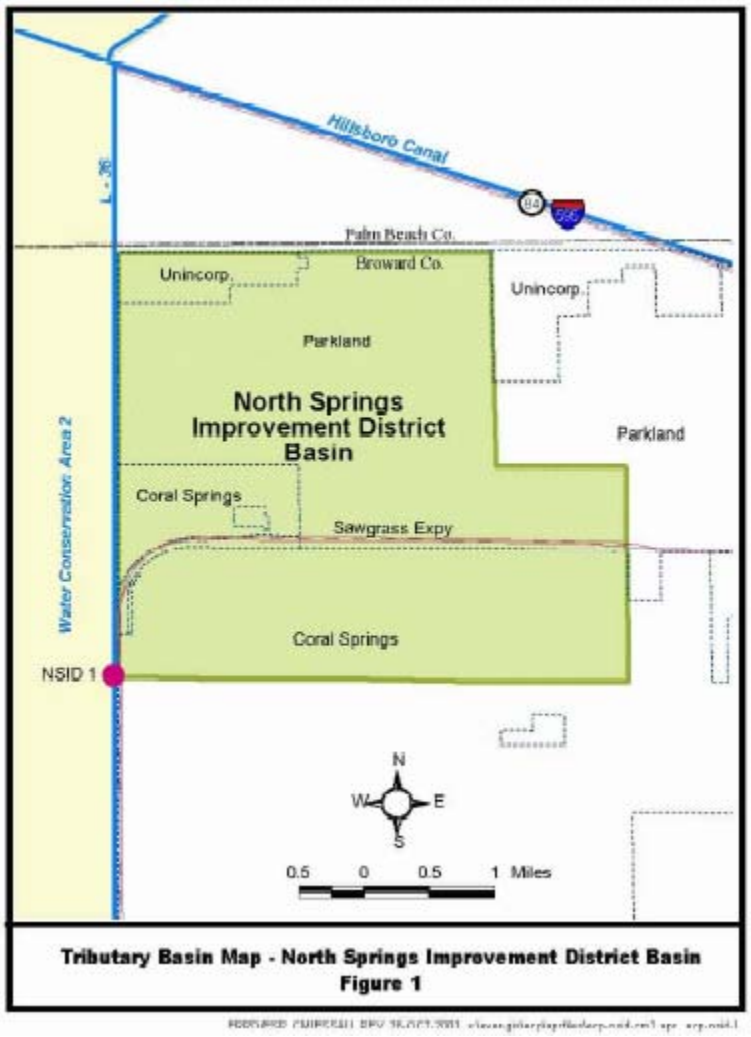


Figure 2. Basin and Water Control Map for North Springs Improvement District

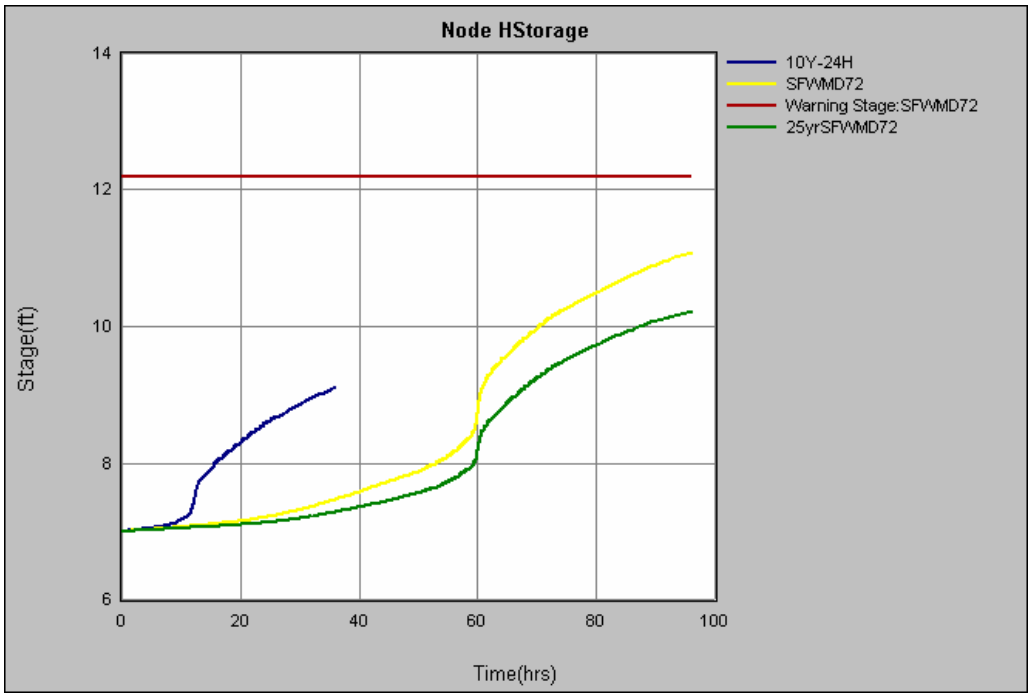


Figure 3. Stage-time graphs for the model storm event in hypothetical storage area HStorage (Model FS-1).

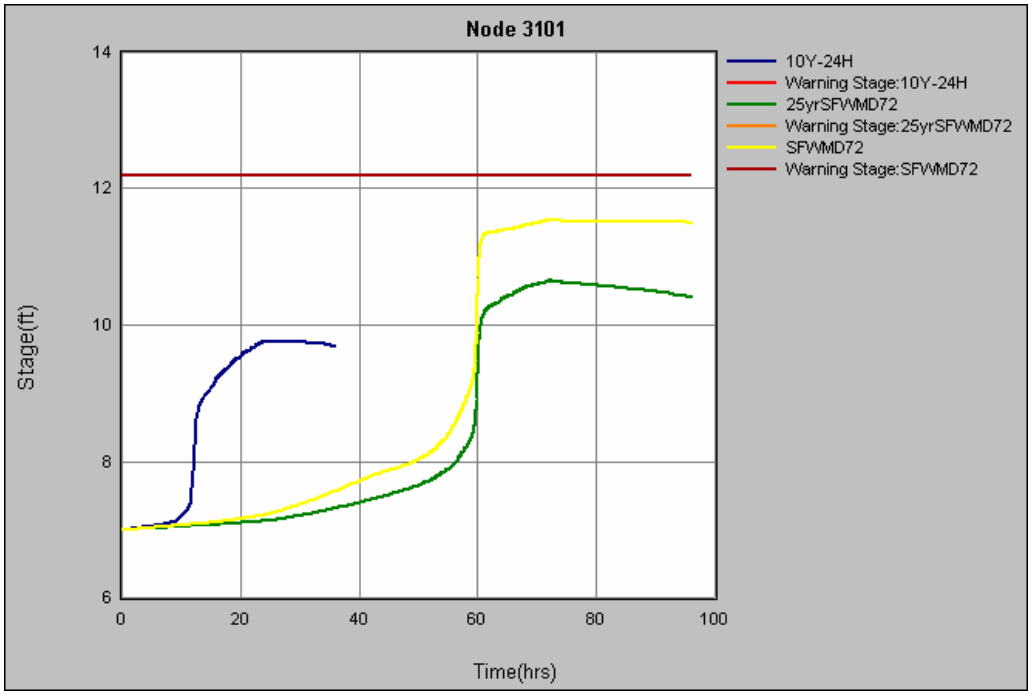


Figure 4. Stage-time graphs for the model storm event in node 3101 connected to HStorage (Model FS-1).

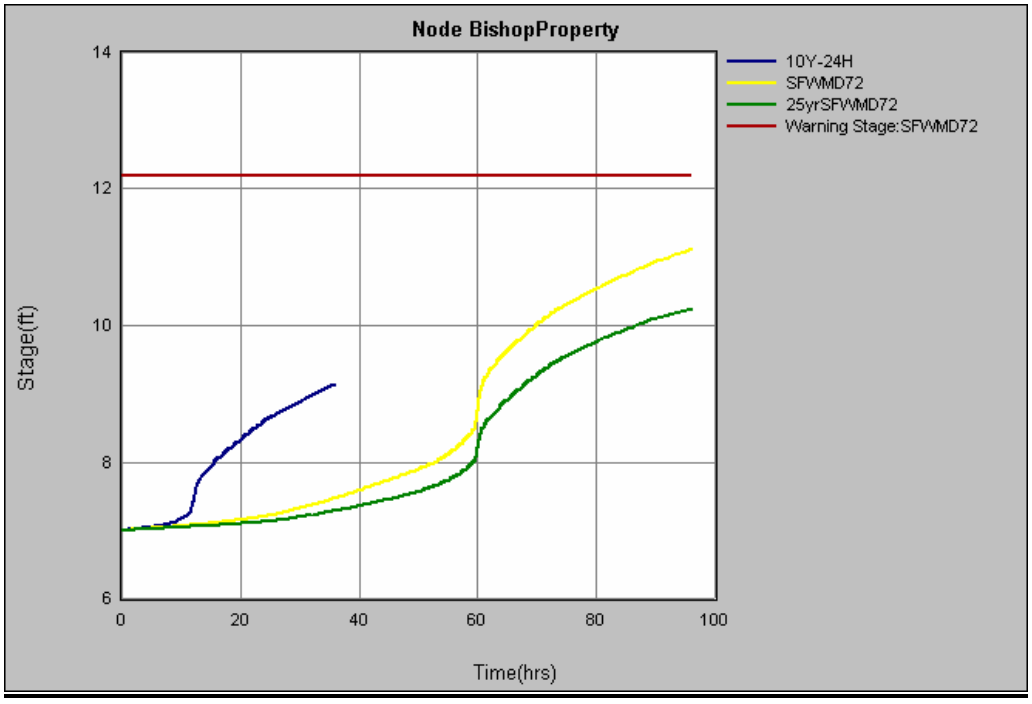


Figure 5. Stage-time graphs for the model storm event in hypothetical storage area Bishop Property (Model FS-2).

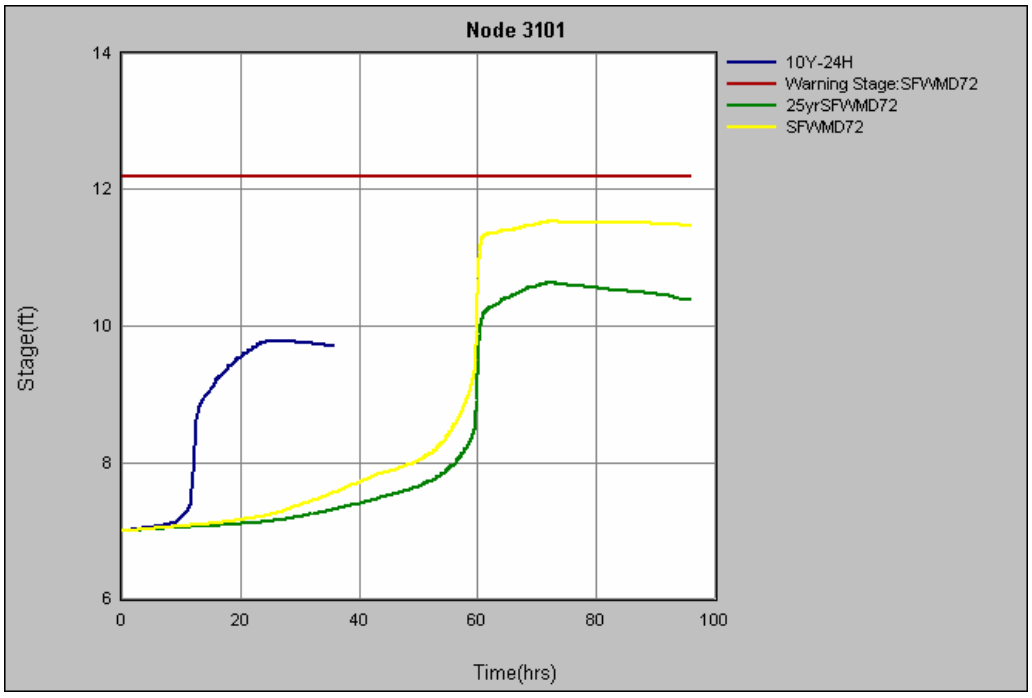


Figure 6. Stage-time graphs for the model storm event in node 3101 connected to Bishop Property (Model FS-2).

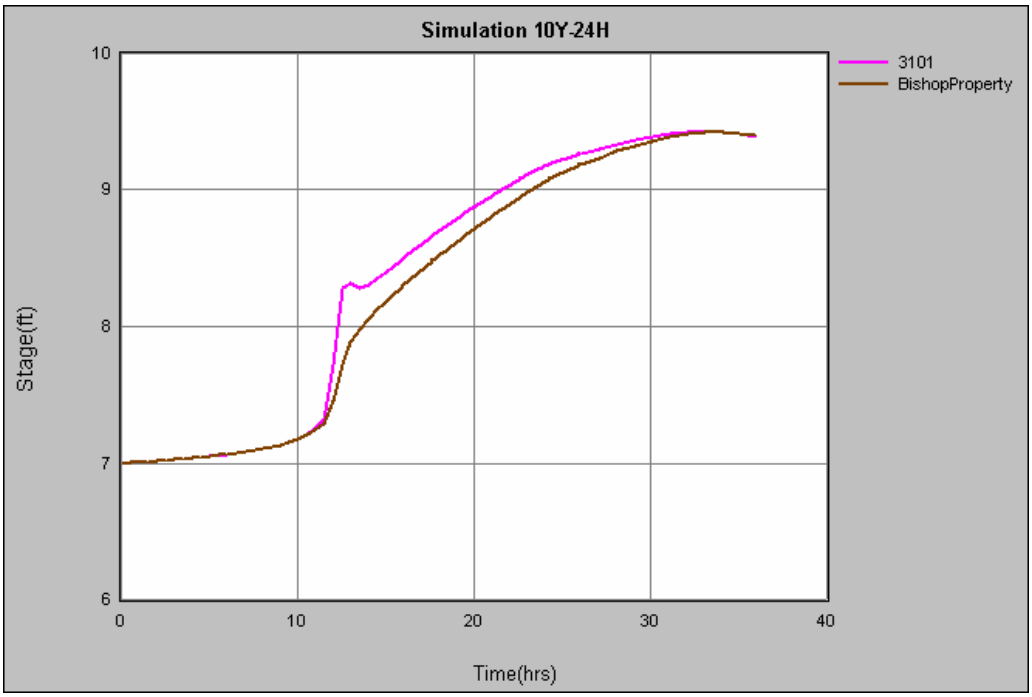


Figure 7. Stage hydrographs for Bishop Property storage area and Node 3101 under 10 Yr-24 hour storm event (Final Model).

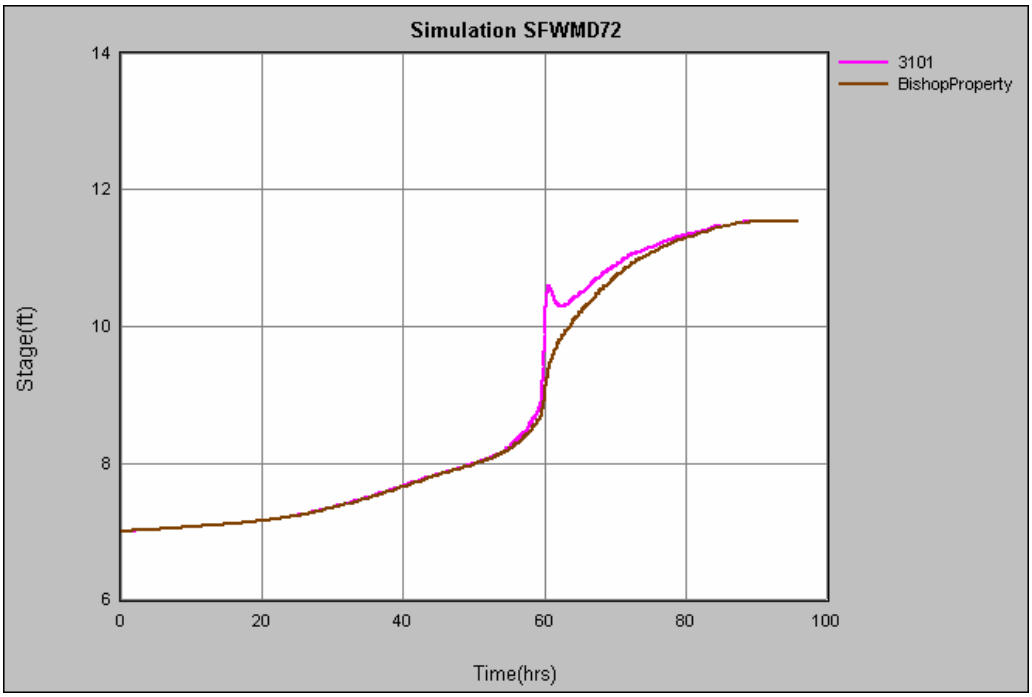


Figure 8. Stage hydrographs for Bishop Property storage area and Node 3101 under 100 Yr-72 Hr storm event (Final Model).

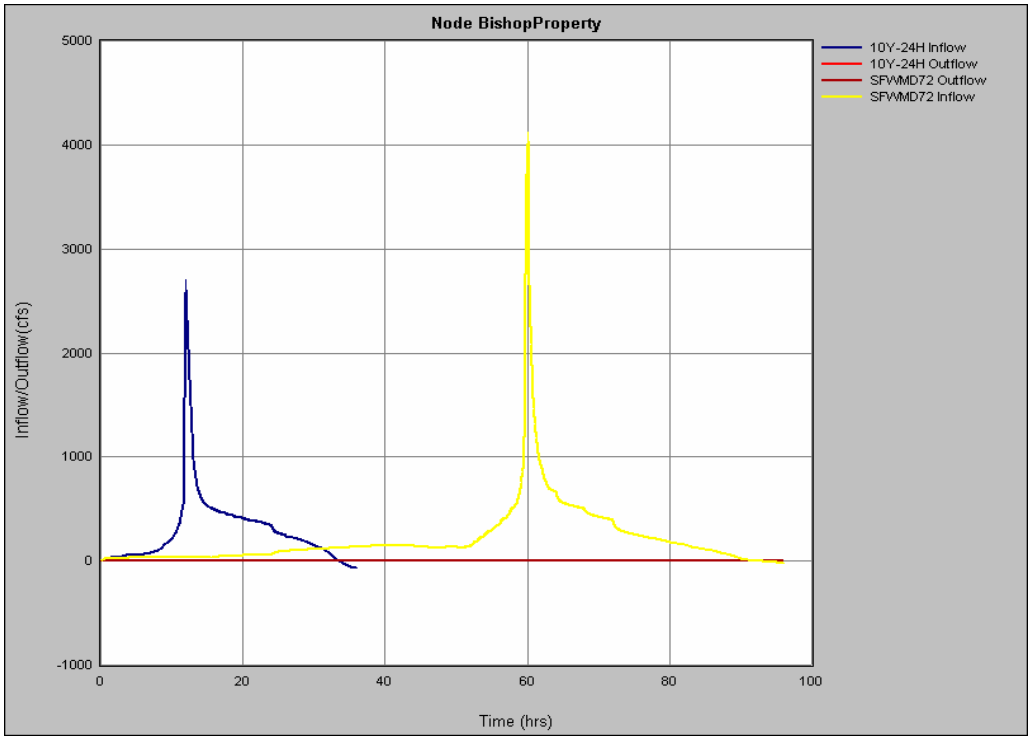


Figure 9. Inflow and Outflow hydrographs for Bishop Property storage area under 10 Yr-24 hour and 100 Yr-72 Hr storm event (Final Model).

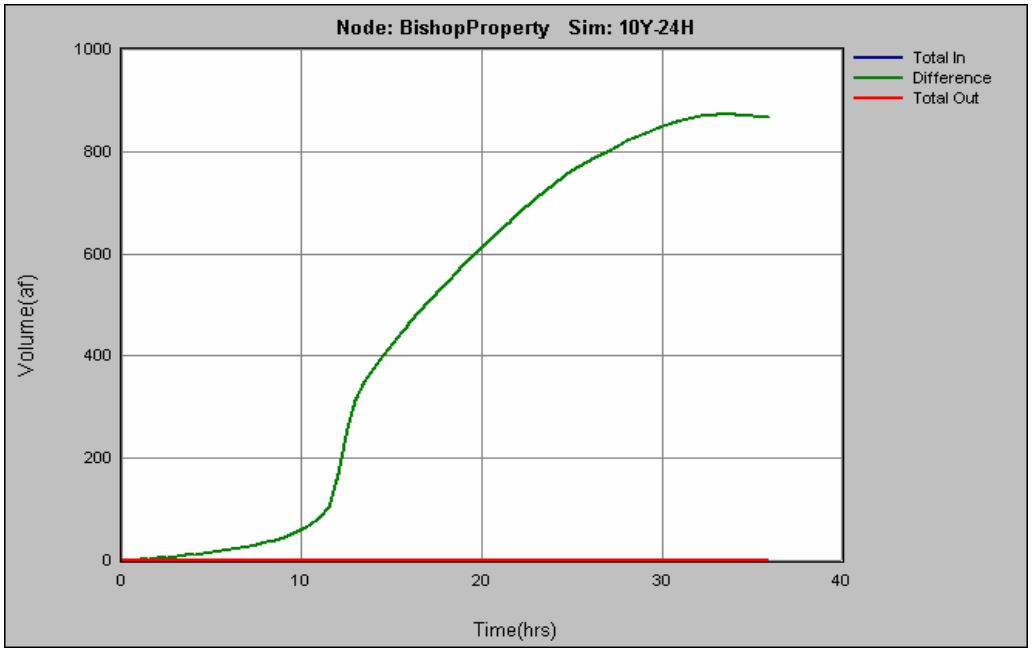


Figure 10. Change in storage volume as a function of time for the Bishop Property storage area under 10 Yr-24 Hr storm even (Final Model).

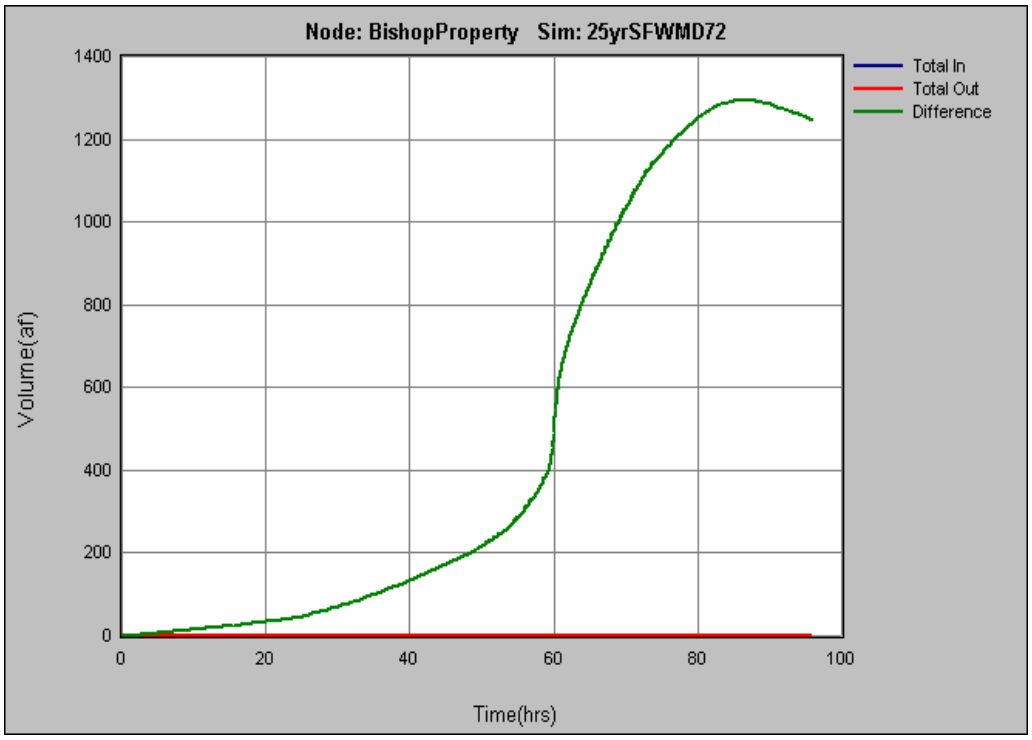


Figure 11. Change in storage volume as a function of time for the Bishop Property storage area under 25 Yr-72 Hr storm event (Final Model).

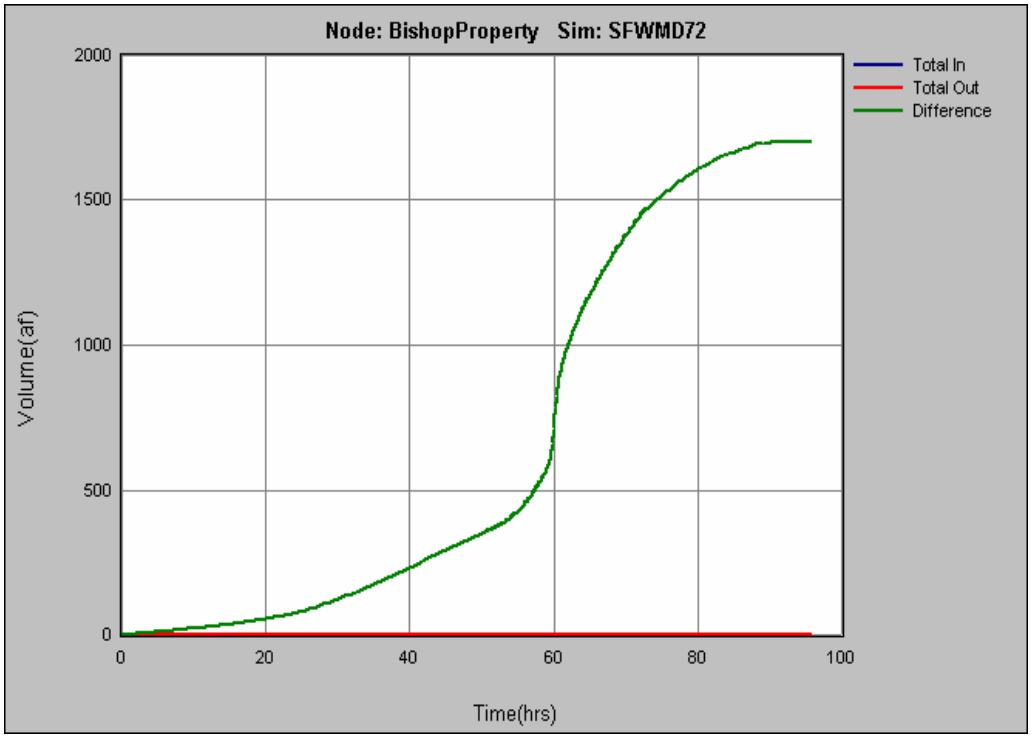


Figure 12. Change in storage volume as a function of time for the Bishop Property storage area under 100 Yr-72 Hr storm event (Final Model).

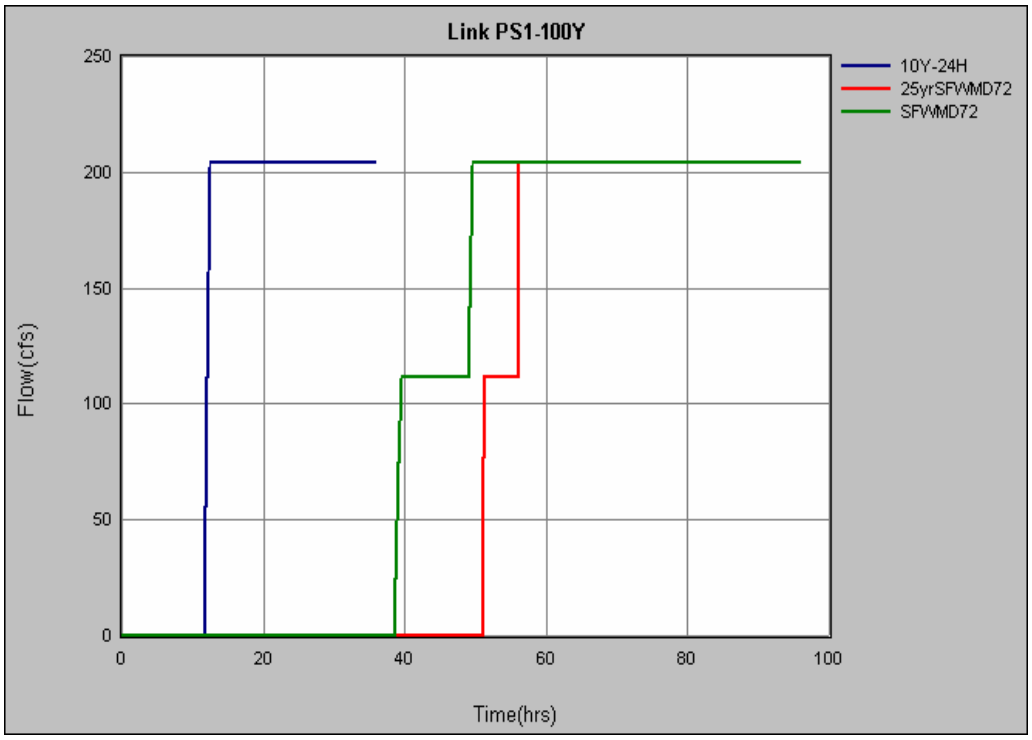


Figure 13. Pump station hydrographs for pump station PS1 under 10 Yr-24 Hr, 25 Yr-72 Hr, and 100 Yr-72 Hr storm event (Final Model).

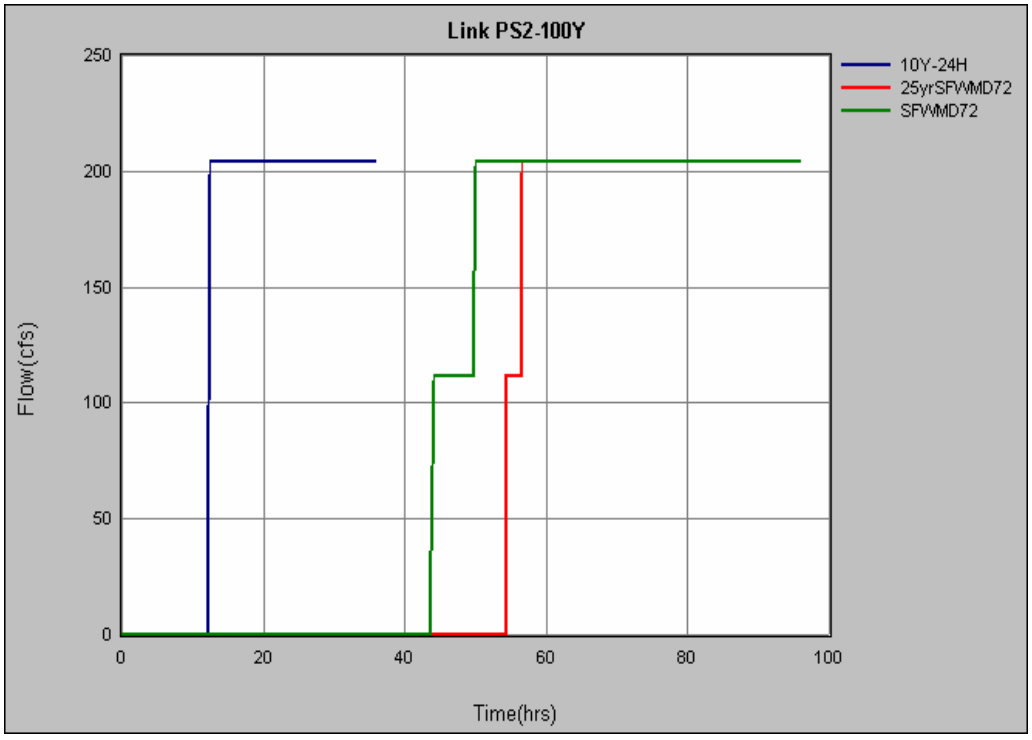


Figure 14. Pump station hydrographs for pump station PS2 under 10 Yr-24 Hr, 25Yr-72 Hr, and 100 Yr-72 Hr storm event (Final Model).

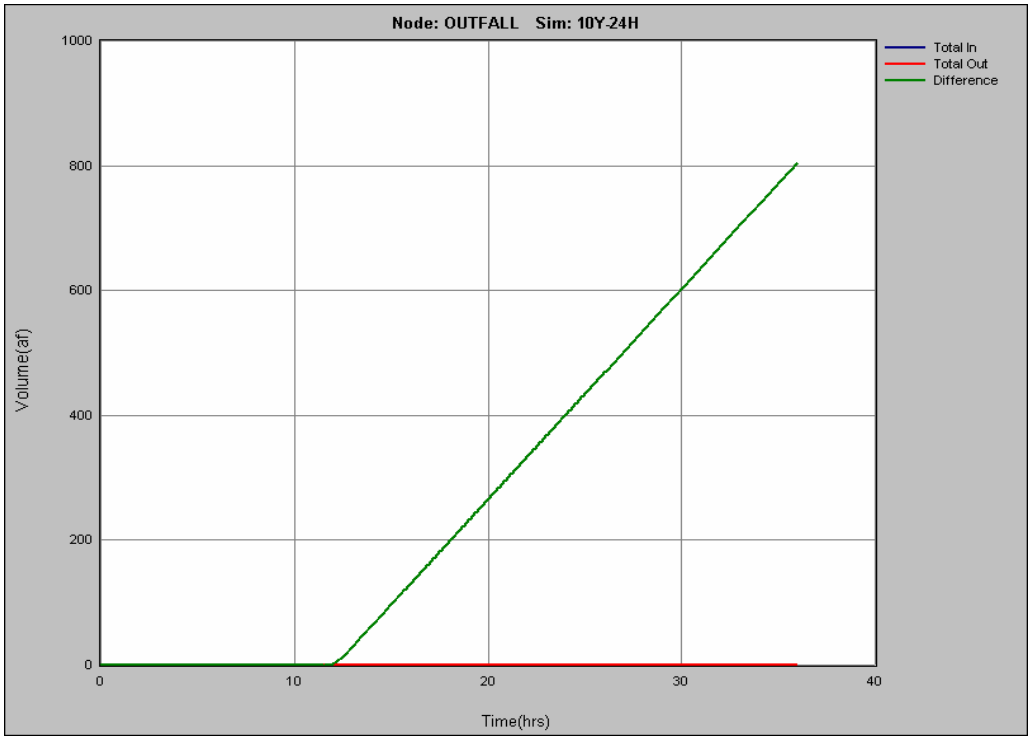


Figure 15. Total volume of flow to the outfall (L-36/Hillsboro Canal) as a function of time for 10 Yr-24 Hr storm event (Final Model).

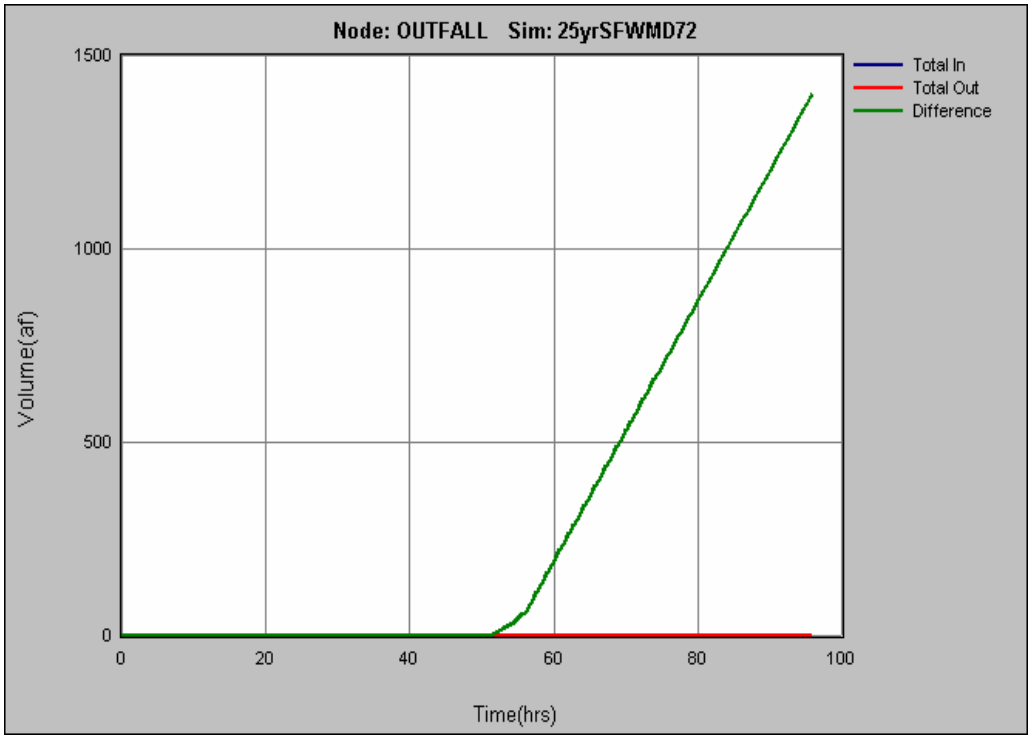


Figure 16. Total volume of flow to the outfall (L-36/Hillsboro Canal) as a function of time for 25 Yr-72 Hr storm event (Final Model).

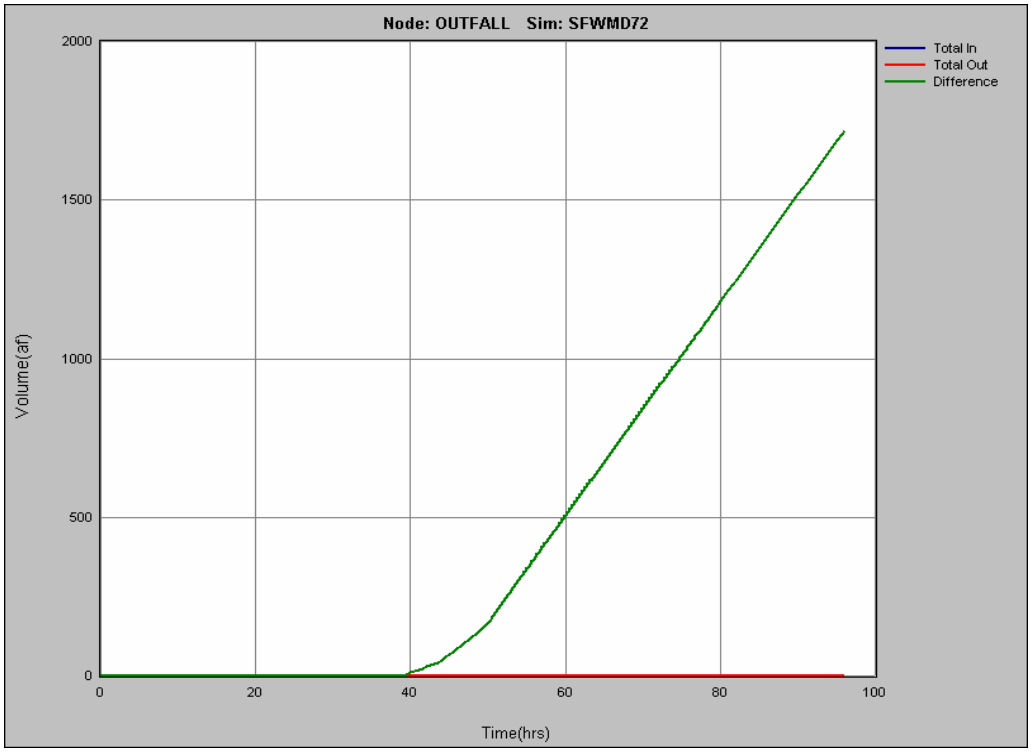
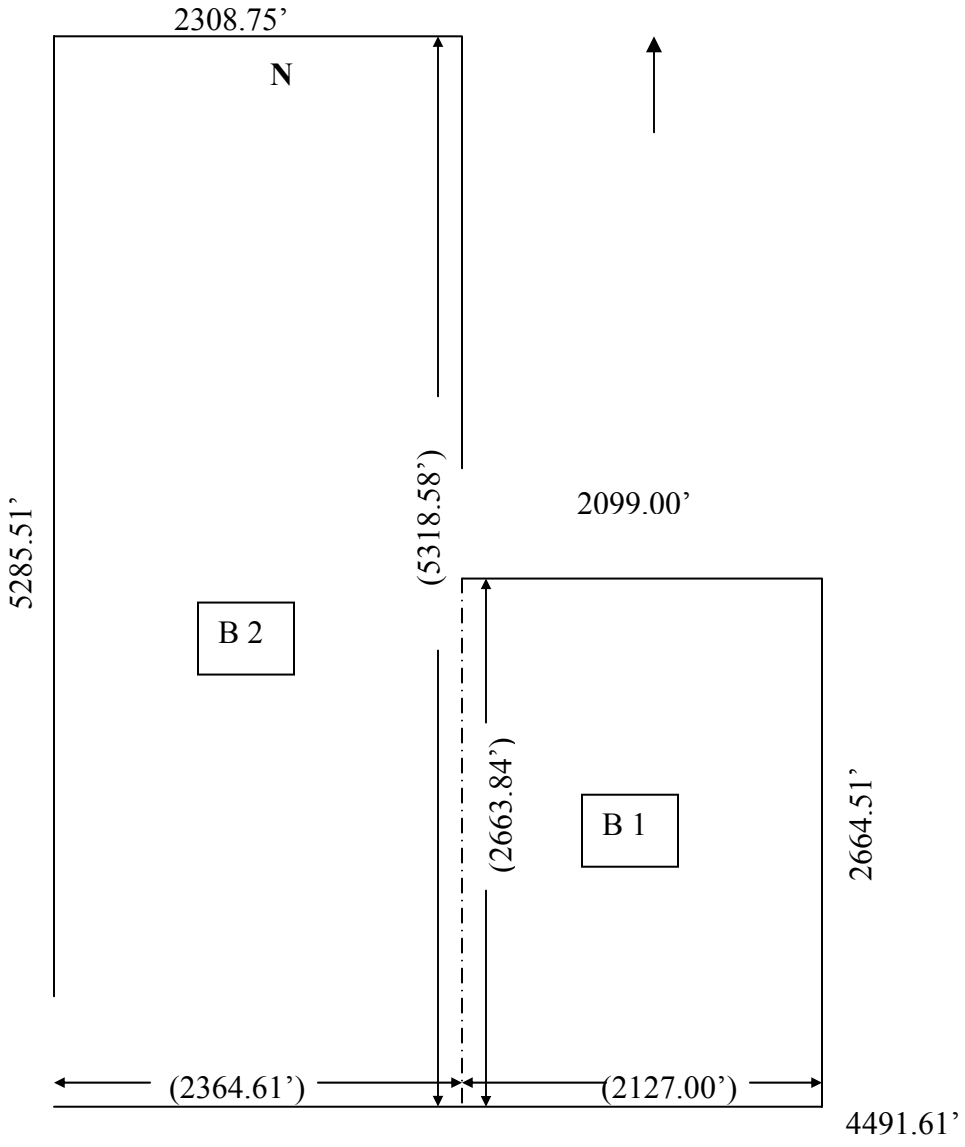


Figure 17. Total volume of flow to the outfall (L-36/Hillsboro Canal) as a function of time for 100 Yr-72 Hr storm event (Final Model).

Appendices

APPENDIX A: CALCULATION OF STAGE AREA CURVE

The plan is divided into two blocks (B1 & B2), to calculate the stage area. B1 is towards NE (right side with Upland Island) of size 2099' x 2663.84' x 2127' x 2664.51'. B2 is 2308.75' x 5285.51' x 2364.61' x 5318.58'.



Existing drawing.

Example: Stage area curve at 8 ft water level.

a) B1

The length of slope = 78'+5'+8'=91'

Total width of section F = 201'

Width to be subtracted from B1 dimensions = 201'-91'=110'

Therefore dimensions for area calculations are:

(2099'-110'+110') = 2099', (2663.84'-110'-110')=2443.84'

(2127'-110'+110')=2127', and (2664.5'-110'-110')=2444.5'

$$\text{(Area) } A = \frac{h(a+b)}{2}$$

Where,

h is average height= (2443.84+2444.5)/2 =2444.17'

a = top width = 2099.0'

b = bottom width = 2127.0'

A_1= 2443.17'(2099+2127)/2 =118.5 acres

b) B2

Total width of section D = 208'

Width to be subtracted from B2 dimensions = 208'-91'=117' on section D side

Width to be subtracted from B2 dimensions = 201'-91'=110' on section F side

(2308.75'-110'-117') = 2081.75', (5285.51'-110'-110')=5065.51'

(2364.61'-110'-117')=2137.6', and (5318.58'-110'-110')= 5098.58'

$$A = \frac{h(a+b)}{2}$$

Where,

h is average height= (5065.51'+5098.58')/2 =5082.05'

a = 2081.75'

b = 2137.6'

A_2 = 5082.05'(2081.75+2137.6)/2 =246.13 acres

Total Area = 118.5 + 246.13 = 364.63 acres @ 8 ft water level.

Modified slope drawing. The slope of section D and F changed to 1.5:1

Example: Stage area curve at 8 ft water level.

a) B1

The length of slope = 58.5'+5'+8'=71.5'

Total width of section *F* = 201'

Width to be subtracted from B1 dimensions = 201'-71.5'=129.5'

Therefore dimensions for area calculations are:

(2099'-129.5'+129.5') = 2099', (2663.84'-129.5'-129.5')=2404.84'

(2127'-129.5'+129.5')=2127', and (2664.5'-129.5'-129.5')=2405.5'

$$\text{(Area) } A = \frac{h(a+b)}{2}$$

Where,

h is average height= (2404.84+2405.5)/2 =2405.17'

a = top width = 2099.0'

b = bottom width = 2127.0'

A_1 = 2405.17'(2099+2127)/2 =116.67 acres

b) B2

Total width of section *D* = 208'

Width to be subtracted from B2 dimensions = 208'-71.5'=136.5' on section D side

Width to be subtracted from B2 dimensions = 201'-71.5'=129.5' on section F side

(2308.75'-129.5'-136.5') = 2042.75', (5285.51'-129.5'-129.5')=5026.51'

(2364.61'-129.5'-136.5')=2098.61', and (5318.58'-129.5'-129.5')= 5059.58'

$$A = \frac{h(a+b)}{2}$$

Where,

h is average height= (5026.51'+5059.58')/2 =5043.05'

a = 2042.75'

b = 2098.61'

A_2 = 5043.05'(2042.75' + 2098.61')/2 =239.72 acres

Total Area = 116.67 + 239.72 = 356.39 acres @ 8 ft water level.

APPENDIX B

INPUT FOR FINAL MODEL

APPENDIX C

FINAL MODEL OUTPUT

C-1: FINAL MODEL OUTPUT: SUMMARY OF MAXIMUM FLOW IN EACH OF THE BASINS

Simulation	Basin	Group	Time Max hrs	Flow Max cfs	Volume in	Volume ft3
10Y-24H	1001	EAST	12.07	275.565	7.037	*********
25yrSFWMD72	1001	EAST	60.03	313.188	10.387	*********
SFWMD72	1001	EAST	60.03	452.144	15.458	*********
10Y-24H	1002	EAST	12.07	459.02	6.955	*********
25yrSFWMD72	1002	EAST	60.03	523.803	10.3	*********
SFWMD72	1002	EAST	60.03	756.976	15.368	*********
10Y-24H	1003	EAST	12.07	1336.639	6.982	*********
25yrSFWMD72	1003	EAST	60.03	1516.884	10.341	*********
SFWMD72	1003	EAST	60.03	2187.026	15.422	*********
10Y-24H	1004	EAST	12.07	717.109	6.76	*********
25yrSFWMD72	1004	EAST	60.03	826.224	10.094	*********
SFWMD72	1004	EAST	60.03	1196.829	15.153	*********
10Y-24H	301	EAST	12.2	1220.961	6.168	*********
25yrSFWMD72	301	EAST	60.13	1514.762	9.41	*********
SFWMD72	301	EAST	60.13	2236.807	14.383	*********
10Y-24H	302	SAWGRASS	12.2	163.179	7.272	*********
25yrSFWMD72	302	SAWGRASS	60.13	185.042	10.669	*********
SFWMD72	302	SAWGRASS	60.13	265.265	15.784	*********
10Y-24H	3101	WEST	12.07	1127.629	6.001	*********
25yrSFWMD72	3101	WEST	60.03	1387.188	9.2	*********
SFWMD72	3101	WEST	60.03	2056.963	14.131	*********
10Y-24H	3102	WEST	12.1	226.525	5.186	*********
25yrSFWMD72	3102	WEST	60.03	300.718	8.197	*********
SFWMD72	3102	WEST	60.03	459.507	12.94	*********
10Y-24H	3201	WEST	12.07	1023.813	6.001	*********
25yrSFWMD72	3201	WEST	60.03	1259.476	9.2	*********
SFWMD72	3201	WEST	60.03	1867.588	14.131	*********
10Y-24H	3202	WEST	12.07	442.598	6.001	*********
25yrSFWMD72	3202	WEST	60.03	544.475	9.2	*********
SFWMD72	3202	WEST	60.03	807.364	14.131	*********
10Y-24H	3203	WEST	12.07	178.525	5.647	*********
25yrSFWMD72	3203	WEST	60.03	227.678	8.74	*********
SFWMD72	3203	WEST	60.03	342.971	13.564	*********
10Y-24H	3301	WEST	12.07	1659.189	6.001	*********
25yrSFWMD72	3301	WEST	60.03	2041.103	9.2	*********
SFWMD72	3301	WEST	60.03	3026.607	14.131	*********

Simulation	Basin	Group	Time Max hrs	Flow Max cfs	Volume in	Volume ft3
10Y-24H	3302	WEST	12.07	1103.532	6.001	*********
25yrSFWMD72	3302	WEST	60.03	1357.544	9.2	*********
SFWMD72	3302	WEST	60.03	2013.006	14.131	*********
10Y-24H	401	WEST	12.07	501.396	5.57	*********
25yrSFWMD72	401	WEST	60.03	641.377	8.683	*********
SFWMD72	401	WEST	60.03	964.722	13.53	*********
10Y-24H	402	WEST	12.1	106.952	5.529	590898.939
25yrSFWMD72	402	WEST	60.03	137.219	8.639	923273.03
SFWMD72	402	WEST	60.03	206.546	13.484	*********
10Y-24H	403	WEST	12.07	1753.123	5.583	*********
25yrSFWMD72	403	WEST	60.03	2240.251	8.697	*********
SFWMD72	403	WEST	60.03	3368.71	13.545	*********
10Y-24H	404	WEST	12.07	369.084	5.613	*********
25yrSFWMD72	404	WEST	60.03	470.509	8.73	*********
SFWMD72	404	WEST	60.03	707.051	13.582	*********
10Y-24H	405	WEST	12.07	510.486	6.224	*********
25yrSFWMD72	405	WEST	60.03	620.594	9.419	*********
SFWMD72	405	WEST	60.03	919.012	14.343	*********
10Y-24H	406	SAWGRASS	12.2	143.875	6.175	*********
25yrSFWMD72	406	SAWGRASS	60.13	177.617	9.437	*********
SFWMD72	406	SAWGRASS	60.13	261.504	14.431	*********
10Y-24H	501	WEST	12.07	686.046	6.184	*********
25yrSFWMD72	501	WEST	60.03	836.218	9.377	*********
SFWMD72	501	WEST	60.03	1239.142	14.299	*********
10Y-24H	502	WEST	12.07	396.003	6.36	*********
25yrSFWMD72	502	WEST	60.03	475.7	9.587	*********
SFWMD72	502	WEST	60.03	700.994	14.543	*********
10Y-24H	503	WEST	12.07	798.257	5.872	*********
25yrSFWMD72	503	WEST	60.03	992.965	9.048	*********
SFWMD72	503	WEST	60.03	1478.159	13.957	*********
10Y-24H	504	WEST	12.1	528.814	5.334	*********
25yrSFWMD72	504	WEST	60.03	691.783	8.388	*********
SFWMD72	504	WEST	60.03	1050.288	13.175	*********
10Y-24H	505	WEST	12.07	120.859	6.392	670826.871
25yrSFWMD72	505	WEST	60.03	144.248	9.647	*********
SFWMD72	505	WEST	60.03	211.77	14.63	*********
10Y-24H	506	WEST	12.07	258.78	5.735	*********
25yrSFWMD72	506	WEST	60.03	328.44	8.806	*********
SFWMD72	506	WEST	60.03	495.39	13.604	*********

Simulation	Basin	Group	Time Max hrs	Flow Max cfs	Volume in	Volume ft3
10Y-24H	507	SAWGRASS	12.2	137.089	6.175	*********
25yrSFWMD72	507	SAWGRASS	60.13	169.241	9.437	*********
SFWMD72	507	SAWGRASS	60.13	249.171	14.431	*********
10Y-24H	601	WEST	12.1	445.373	5.44	*********
25yrSFWMD72	601	WEST	60.03	578.991	8.479	*********
SFWMD72	601	WEST	60.03	879.309	13.248	*********
10Y-24H	602	WEST	12.1	2213.454	5.352	*********
25yrSFWMD72	602	WEST	60.03	2898.326	8.38	*********
SFWMD72	602	WEST	60.03	4411.224	13.14	*********
10Y-24H	603	WEST	12.07	680.35	6.228	*********
25yrSFWMD72	603	WEST	60.03	819.913	9.473	*********
SFWMD72	603	WEST	60.03	1206.504	14.449	*********
10Y-24H	701	WEST	12.07	1168.684	6.108	*********
25yrSFWMD72	701	WEST	60.03	1426.596	9.318	*********
SFWMD72	701	WEST	60.03	2110.583	14.26	*********
10Y-24H	702	WEST	12.07	123.146	6.051	667768.947
25yrSFWMD72	702	WEST	60.03	150.029	9.285	*********
SFWMD72	702	WEST	60.03	221.353	14.251	*********
10Y-24H	703	WEST	12.07	928.135	6.659	*********
25yrSFWMD72	703	WEST	60.03	1093.68	9.912	*********
SFWMD72	703	WEST	60.03	1602.959	14.891	*********
10Y-24H	704	SAWGRASS	12.2	227.256	6.175	*********
25yrSFWMD72	704	SAWGRASS	60.13	280.554	9.437	*********
SFWMD72	704	SAWGRASS	60.13	413.057	14.431	*********
10Y-24H	801	WEST	12.07	351.652	5.61	*********
25yrSFWMD72	801	WEST	60.03	448.451	8.726	*********
SFWMD72	801	WEST	60.03	674.04	13.576	*********
10Y-24H	802	WEST	12.1	738.092	5.529	*********
25yrSFWMD72	802	WEST	60.03	946.968	8.639	*********
SFWMD72	802	WEST	60.03	1425.408	13.484	*********
10Y-24H	803	WEST	12.1	657.342	5.456	*********
25yrSFWMD72	803	WEST	60.03	848.053	8.559	*********
SFWMD72	803	WEST	60.03	1278.557	13.397	*********
10Y-24H	804	WEST	12.1	233.472	5.473	*********
25yrSFWMD72	804	WEST	60.03	300.256	8.59	*********
SFWMD72	804	WEST	60.03	451.793	13.444	*********
10Y-24H	901	WEST	12.1	549.039	5.301	*********
25yrSFWMD72	901	WEST	60.03	719.54	8.359	*********
SFWMD72	901	WEST	60.03	1092.255	13.152	*********

Simulation	Basin	Group	Time Max hrs	Flow Max cfs	Volume in	Volume ft3
10Y-24H	902	WEST	12.07	348.442	5.769	*********
25yrSFWMD72	902	WEST	60.03	435.498	8.95	*********
SFWMD72	902	WEST	60.03	648.344	13.866	*********
10Y-24H	903	WEST	12.07	117.145	5.826	638663
25yrSFWMD72	903	WEST	60.03	145.814	9.012	987995.424
SFWMD72	903	WEST	60.03	216.844	13.933	*********
10Y-24H	904	WEST	12.07	176.169	5.894	964698.807
25yrSFWMD72	904	WEST	60.03	218.271	9.085	*********
SFWMD72	904	WEST	60.03	324.224	14.01	*********
10Y-24H	905	WEST	12.07	137.081	5.863	749415.446
25yrSFWMD72	905	WEST	60.03	170.209	9.052	*********
SFWMD72	905	WEST	60.03	252.979	13.975	*********
10Y-24H	906	WEST	12.07	1323.637	5.723	*********
25yrSFWMD72	906	WEST	60.03	1666.886	8.877	*********
SFWMD72	906	WEST	60.03	2491.308	13.765	*********
10Y-24H	OUTFALL	BASE	0	0	0	0
25yrSFWMD72	OUTFALL	BASE	0	0	0	0
SFWMD72	OUTFALL	BASE	0	0	0	0

C-2: SUMMARY OF MAXIMUM STAGE HEIGHTS

IN EACH OF THE NODES

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1001	EAST	10Y-24H	14.73	11.549	13	-0.0029	946392	12.08	274.622	26.16	30.811
1002	EAST	10Y-24H	14.6	11.54	13	0.0029	1521582	12.08	404.974	15.03	39.793
1003	EAST	10Y-24H	14.47	11.532	13	0.0046	3131487	12.08	1311.028	11.72	243.723
1004	EAST	10Y-24H	13.06	11.641	13	0.005	1415511	12.08	714.964	12.57	134.083
301	EAST	10Y-24H	13.97	11.337	13	0.0024	4251666	12.25	1220.539	12.92	241.477
302	SAWGRASS	10Y-24H	13.68	12.46	13	0.0015	721103	12.25	162.3	13.68	37.109
3101	WEST	10Y-24H	33.42	9.422	12.2	0.0019	1692862	12.08	1126.248	12.3	459.067
3102	WEST	10Y-24H	24.26	9.651	12.2	0.0019	481990	12.08	241.97	12.66	26.904
3201	WEST	10Y-24H	24.21	9.688	12.2	0.0023	1564214	12.08	1011.836	12.23	208.311
3202	WEST	10Y-24H	24.12	9.867	12.2	0.0023	684264	12.08	446.587	12.12	94.642
3203	WEST	10Y-24H	24.24	9.697	12.2	0.002	468518	12.08	252.063	12.52	48.173
3301	WEST	10Y-24H	24.11	9.903	12.2	0.0027	2570278	12.08	1615.985	13.26	50.485
3302	WEST	10Y-24H	24.12	9.875	12.2	0.0026	1706682	12.08	1106.865	13.45	131.757
401	WEST	10Y-24H	24.11	9.904	12.2	0.0025	880687	12.08	501.317	13.14	23.93
402	WEST	10Y-24H	24.09	9.925	12.2	0.0024	173208	12.08	106.938	12.2	12.243
403	WEST	10Y-24H	24.09	9.924	12.2	0.0024	3083877	12.08	1943.819	12.66	301.338
404	WEST	10Y-24H	20.12	10.031	12.2	-0.0047	712740	12.08	606.009	13.94	256.738
405	WEST	10Y-24H	24.14	9.934	12.2	0.003	1508151	12.08	537.418	26.59	26.217
406	SAWGRASS	10Y-24H	13.52	10.787	12.2	0.0014	618768	12.25	143.799	13.52	39.753
501	WEST	10Y-24H	24.12	9.899	12.2	0.0024	1892051	12.08	905.304	13.36	27.966
502	WEST	10Y-24H	24.12	9.908	12.2	0.0025	1072978	12.08	496.915	13.97	95.283
503	WEST	10Y-24H	24.12	9.899	12.2	0.0024	1644043	12.08	664.169	16.14	133.461
504	WEST	10Y-24H	24.24	9.713	12.2	0.0021	1267039	12.08	580.281	12.98	91.221
505	WEST	10Y-24H	24.26	9.652	12.2	0.0021	237340	12.08	120.607	12.2	10.374
506	WEST	10Y-24H	24.46	9.66	12.2	0.0026	934923	12.08	258.625	31.95	9.755
507	SAWGRASS	10Y-24H	13.65	10.828	12.2	0.0015	603330	12.25	137.017	13.65	33.965
601	WEST	10Y-24H	24.34	9.638	12.2	0.0021	1265544	12.08	439.126	31.89	17.9
602	WEST	10Y-24H	24.29	9.635	12.2	0.0019	5824240	12.08	2515.044	12.15	203.963
603	WEST	10Y-24H	24.11	9.721	12.2	0.0023	799355	12.08	615.028	14.67	249.936
701	WEST	10Y-24H	23.82	9.821	12.2	0.0024	2089649	12.08	1547.979	12.45	511.614
702	WEST	10Y-24H	24.06	9.767	12.2	0.0025	64757	12.08	124.454	12.09	91.729
703	WEST	10Y-24H	24.07	9.768	12.2	0.0026	3099958	12.08	1327.06	15.37	344.48
704	SAWGRASS	10Y-24H	13.21	10.605	12.2	-0.0019	878238	12.25	227.136	12.92	86.871
801	WEST	10Y-24H	23.64	9.92	12.2	0.0025	701173	12.08	386.2	14.47	100.623
802	WEST	10Y-24H	22.66	9.973	12.2	0.0028	1217996	12.08	919.315	13.24	326.882
803	WEST	10Y-24H	22.94	9.908	12.2	0.0027	823270	12.08	818.843	12.77	376.619
804	WEST	10Y-24H	23.71	9.859	12.2	0.0026	276664	12.08	198.71	12.58	80.656
901	WEST	10Y-24H	20.19	10.052	12.2	0.003	1012545	12.08	594.44	14.45	62.529
902	WEST	10Y-24H	14.18	10.667	12.2	-0.0047	524123	12.08	580.48	12.24	291.948
903	WEST	10Y-24H	15.76	10.585	12.2	0.0047	155346	12.12	399.184	12.33	298.367
904	WEST	10Y-24H	16.36	10.505	12.2	0.0038	268611	12.11	455.395	12.47	285.633
905	WEST	10Y-24H	17.66	10.36	12.2	0.0036	183874	12.21	381.55	12.61	296.95
906	WEST	10Y-24H	20.19	10.052	12.2	0.003	1997595	12.08	1554.947	13.25	346.09
BishopProperty	WEST	10Y-24H	33.42	9.422	12.2	0.002	16819173	12.08	2775.816	0	0
OUTFALL	BASE	10Y-24H	0	7	12.2	0	0	12.15	407.926	0	0

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1001	EAST	25yrSFWMD72	64.12	11.969	13	0.0033	1152550	60	309.209	73.81	20.864
1002	EAST	25yrSFWMD72	64.02	11.962	13	0.0034	1977239	60	490.178	57.67	39.214
1003	EAST	25yrSFWMD72	64.12	11.956	13	0.004	4243402	60	1469.949	54.7	220.528
1004	EAST	25yrSFWMD72	64.11	11.963	13	0.0045	1688319	60	815.542	60.67	152.609
301	EAST	25yrSFWMD72	62.58	11.726	13	0.0027	6226423	60.17	1507.129	58.27	189.241
302	SAWGRASS	25yrSFWMD72	61.25	12.768	13	-0.0021	834399	60.17	183.904	60.87	58.222
3101	WEST	25yrSFWMD72	85.99	10.508	12.2	0.0025	2006557	60	1367.274	60.21	529.894
3102	WEST	25yrSFWMD72	72.22	10.695	12.2	0.0031	555453	60	308.643	60.49	30.684
3201	WEST	25yrSFWMD72	72.24	10.726	12.2	0.0034	2304989	60	1221.04	60.18	225.277
3202	WEST	25yrSFWMD72	72.14	10.915	12.2	0.0037	915387	60	487.021	60.09	68.642
3203	WEST	25yrSFWMD72	72.27	10.737	12.2	0.0033	539622	60.08	317.173	60.43	61.595
3301	WEST	25yrSFWMD72	72.14	10.959	12.2	0.004	4150792	60	1972.085	61.71	53.706
3302	WEST	25yrSFWMD72	72.14	10.929	12.2	0.004	2542960	60	1362.898	61.36	146.949
401	WEST	25yrSFWMD72	72.14	10.959	12.2	0.004	1228925	60	631.616	61.38	32.572
402	WEST	25yrSFWMD72	72.16	10.977	12.2	0.0039	476252	60	135.124	60.18	16.721
403	WEST	25yrSFWMD72	72.14	10.976	12.2	0.0039	5973470	60	2406.212	60.33	368.946
404	WEST	25yrSFWMD72	68.92	11.08	12.2	0.0043	1407289	60.08	640.034	61.42	194.82
405	WEST	25yrSFWMD72	72.19	10.986	12.2	0.0034	2192215	60	644.511	75.62	26.157
406	SAWGRASS	25yrSFWMD72	61.53	11.156	12.2	0.0011	746587	60.17	176.704	60.45	51.093
501	WEST	25yrSFWMD72	72.17	10.948	12.2	0.0036	2240908	60.08	1073.406	60.82	76.493
502	WEST	25yrSFWMD72	72.16	10.958	12.2	0.0036	1274708	60.08	614.381	61.14	114.252
503	WEST	25yrSFWMD72	72.17	10.948	12.2	0.0036	3451096	60	846.739	63.77	132.131
504	WEST	25yrSFWMD72	72.36	10.754	12.2	0.0033	2561875	60.08	781.423	60.74	100.845
505	WEST	25yrSFWMD72	72.22	10.696	12.2	0.0031	288284	60	142.266	60.86	5.214
506	WEST	25yrSFWMD72	72.36	10.704	12.2	0.003	1026916	60	323.413	96	5.667
507	SAWGRASS	25yrSFWMD72	61.19	11.162	12.2	-0.0015	713568	60.17	168.37	60.8	58.118
601	WEST	25yrSFWMD72	72.29	10.681	12.2	0.0029	1414435	60	562.719	96	11.728
602	WEST	25yrSFWMD72	72.29	10.675	12.2	0.003	7522301	60	3252.977	56.5	203.963
603	WEST	25yrSFWMD72	72.12	10.763	12.2	0.0034	1089379	60	754.395	60.14	265.006
701	WEST	25yrSFWMD72	72.09	10.855	12.2	0.0037	2914588	60.08	1957.223	60.22	661.37
702	WEST	25yrSFWMD72	72.09	10.806	12.2	0.0039	125046	60.08	161.299	60.08	119.435
703	WEST	25yrSFWMD72	72.12	10.809	12.2	0.0033	3452951	60.08	1751.337	62.93	342.881
704	SAWGRASS	25yrSFWMD72	61.53	10.966	12.2	0.0013	1075894	60.17	279.111	60.36	78.23
801	WEST	25yrSFWMD72	72.09	10.955	12.2	0.0039	1336713	60.08	527.886	61.22	111.4
802	WEST	25yrSFWMD72	68.22	11.009	12.2	0.0043	2009882	60.08	1159.117	61.01	304.291
803	WEST	25yrSFWMD72	68.26	10.944	12.2	0.0041	1181692	60	1057.378	60.24	443.529
804	WEST	25yrSFWMD72	72.09	10.893	12.2	0.004	772916	60.09	289.328	60.18	113.592
901	WEST	25yrSFWMD72	68.21	11.075	12.2	0.0042	2223750	60.08	780.115	60.86	58.469
902	WEST	25yrSFWMD72	64.19	11.483	12.2	0.005	1222533	60	582.785	59.88	235.481
903	WEST	25yrSFWMD72	64.21	11.438	12.2	-0.005	331189	59.97	373.479	59.87	249.033
904	WEST	25yrSFWMD72	64.22	11.389	12.2	0.0049	514455	60	460.194	60.01	236.923
905	WEST	25yrSFWMD72	64.32	11.292	12.2	0.0047	354739	60	404.59	60.01	256.155
906	WEST	25yrSFWMD72	68.19	11.075	12.2	0.0044	4447789	60	1898.204	60.36	305.664
BishopProperty	WEST	25yrSFWMD72	86.01	10.508	12.2	0.0022	17084728	60.08	2938.284	0	0
OUTFALL	BASE	25yrSFWMD72	0	7	12.2	0	0	56.5	407.926	0	0

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1001	EAST	SFWMD72	64.8	12.622	13	0.0034	1467508	60	446.806	73.5	18.096
1002	EAST	SFWMD72	64.64	12.617	13	0.0034	2496807	60	744.775	55.1	37.856
1003	EAST	SFWMD72	64.57	12.611	13	0.0039	5680565	60.08	2200.271	52.19	190.796
1004	EAST	SFWMD72	64.57	12.613	13	0.0041	2676882	60	1182.548	60.31	338.407
301	EAST	SFWMD72	65.17	12.355	13	0.0032	9295760	60.17	2223.779	55.77	174.76
302	SAWGRASS	SFWMD72	61.69	13.154	13	-0.0015	976518	60.17	263.526	60.62	59.798
3101	WEST	SFWMD72	92.89	11.546	12.2	0.004	4826489	60	2030.41	60.26	721.259
3102	WEST	SFWMD72	72.29	11.653	12.2	0.0038	1171280	60	458.013	60.43	41.828
3201	WEST	SFWMD72	72.39	11.674	12.2	0.0044	5196648	60	1807.751	60.09	272.735
3202	WEST	SFWMD72	72.24	11.861	12.2	0.0039	1991081	60	750.539	60.13	139.948
3203	WEST	SFWMD72	72.39	11.686	12.2	0.0037	967159	60.06	452.547	60.41	103.694
3301	WEST	SFWMD72	72.2	11.91	12.2	0.0048	8944852	60	2937.497	63.25	47.228
3302	WEST	SFWMD72	72.2	11.882	12.2	0.0047	5523423	60	1996.863	61.89	130.719
401	WEST	SFWMD72	72.2	11.91	12.2	0.0047	2678650	60	951.684	60.34	58.849
402	WEST	SFWMD72	72.29	11.92	12.2	0.0046	970336	60	203.749	59.97	16.2
403	WEST	SFWMD72	72.24	11.92	12.2	0.0044	10494319	60	3504.377	60.03	405.81
404	WEST	SFWMD72	72.19	12.003	12.2	0.0047	2322380	60	843.761	57.04	166.903
405	WEST	SFWMD72	72.34	11.93	12.2	0.0033	3212286	60	941.671	75.32	24.549
406	SAWGRASS	SFWMD72	72.27	12.022	12.2	0.002	1047007	60.17	259.959	59.84	33.626
501	WEST	SFWMD72	72.27	11.894	12.2	0.0036	3878950	60.01	1564.452	60.43	179.184
502	WEST	SFWMD72	72.25	11.903	12.2	0.0035	2156315	60	878.356	60.39	150.227
503	WEST	SFWMD72	72.29	11.894	12.2	0.0036	5471530	60.08	1654.768	68.04	113.29
504	WEST	SFWMD72	72.49	11.705	12.2	0.0036	4209155	60.08	1157.166	59.96	92.86
505	WEST	SFWMD72	72.27	11.654	12.2	0.0038	505905	60	209.123	61.44	11.504
506	WEST	SFWMD72	72.39	11.661	12.2	0.003	1598072	60	488.604	66.37	3.824
507	SAWGRASS	SFWMD72	72.3	11.921	12.2	0.0017	963870	60.17	247.699	60.11	41.657
601	WEST	SFWMD72	72.32	11.639	12.2	0.0032	2493747	60	857.417	65.29	15.02
602	WEST	SFWMD72	72.34	11.633	12.2	0.0034	12852933	60	4819.198	49.59	203.963
603	WEST	SFWMD72	72.19	11.734	12.2	0.0044	2470607	60	1088.975	60.11	326.515
701	WEST	SFWMD72	72.15	11.832	12.2	0.0043	5680361	60	2679.806	60.11	713.876
702	WEST	SFWMD72	72.15	11.783	12.2	0.0046	399261	60	229.982	60.01	152.4
703	WEST	SFWMD72	72.19	11.788	12.2	0.0035	5165386	60.02	2311.692	64.97	316.833
704	SAWGRASS	SFWMD72	72.3	11.794	12.2	0.0022	1528406	60.17	410.616	59.84	56.794
801	WEST	SFWMD72	72.22	11.918	12.2	0.0044	2280087	60	774.443	59.51	70.704
802	WEST	SFWMD72	72.12	11.972	12.2	0.0047	4315965	60	1600.101	59.52	239.006
803	WEST	SFWMD72	72.12	11.916	12.2	0.005	3292130	60	1368.437	60.1	459.399
804	WEST	SFWMD72	72.19	11.866	12.2	0.0045	1443750	60	463.372	59.82	106.429
901	WEST	SFWMD72	72.19	12.019	12.2	0.0045	4029215	60	1132.703	59.99	57.411
902	WEST	SFWMD72	68.2	12.157	12.2	0.005	1799238	60	765.29	59.7	192.214
903	WEST	SFWMD72	68.2	12.148	12.2	-0.005	561336	59.78	327.574	59.72	204.026
904	WEST	SFWMD72	68.25	12.13	12.2	0.0049	866806	60	456.75	59.75	197.638
905	WEST	SFWMD72	68.3	12.115	12.2	0.0048	661939	60	419.444	59.98	217.344
906	WEST	SFWMD72	72.1	12.028	12.2	0.0047	7791279	60	2675.399	59.89	272.753
BishopProperty	WEST	SFWMD72	92.9	11.546	12.2	0.0028	17143976	60.05	4025.286	0	0
OUTFALL	BASE	SFWMD72	0	7	12.2	0	0	49.59	407.926	0	0

APPENDIX D

COMPARISON OF BASE MODEL MAXIMUM STAGE ELEVATIONS WITH FINAL MODEL MAXIMUM STAGE ELEVATIONS

Node	10 Year - 24 Hrs			25 Year - 72 Hrs			100 Year - 72 Hrs		
	Max Stage (Ft)			Max Stage (Ft)			Max Stage (Ft)		
	Base	Final	Difference	Base		Difference	Base	Final	Difference
1001	11.576	11.549	0.027	12.027	11.969	0.058	12.665	12.622	0.043
1002	11.566	11.540	0.026	12.021	11.962	0.059	12.660	12.617	0.043
1003	11.565	11.532	0.033	12.020	11.956	0.064	12.654	12.611	0.043
1004	11.751	11.641	0.110	12.028	11.963	0.065	12.657	12.613	0.044
301	11.339	11.337	0.002	11.749	11.726	0.023	12.406	12.355	0.051
302	12.460	12.460	0.000	12.769	12.768	0.001	13.162	13.154	0.008
3101	10.193	9.422	0.771	11.191	10.508	0.683	12.051	11.546	0.505
3102	10.182	9.651	0.531	11.179	10.695	0.484	12.042	11.653	0.389
3201	10.209	9.688	0.521	11.202	10.726	0.476	12.062	11.674	0.388
3202	10.249	9.867	0.382	11.233	10.915	0.318	12.091	11.861	0.230
3203	10.209	9.697	0.512	11.201	10.737	0.464	12.062	11.686	0.376
3301	10.253	9.903	0.350	11.245	10.959	0.286	12.098	11.910	0.188
3302	10.247	9.875	0.372	11.239	10.929	0.310	12.093	11.882	0.211
401	10.255	9.904	0.351	11.245	10.959	0.286	12.099	11.910	0.189
402	10.267	9.925	0.342	11.250	10.977	0.273	12.105	11.920	0.185
403	10.267	9.924	0.343	11.250	10.976	0.274	12.105	11.920	0.185
404	10.330	10.031	0.299	11.313	11.080	0.233	12.153	12.003	0.150
405	10.267	9.934	0.333	11.248	10.986	0.262	12.122	11.930	0.192
406	10.787	10.787	0.000	11.191	11.156	0.035	12.113	12.022	0.091
501	10.258	9.899	0.359	11.238	10.948	0.290	12.097	11.894	0.203
502	10.260	9.908	0.352	11.241	10.958	0.283	12.099	11.903	0.196
503	10.258	9.899	0.359	11.237	10.948	0.289	12.096	11.894	0.202
504	10.209	9.713	0.496	11.201	10.754	0.447	12.062	11.705	0.357
505	10.182	9.652	0.530	11.180	10.696	0.484	12.042	11.654	0.388
506	10.186	9.660	0.526	11.181	10.704	0.477	12.044	11.661	0.383
507	10.828	10.828	0.000	11.175	11.162	0.013	12.062	11.921	0.141
601	10.178	9.638	0.540	11.173	10.681	0.492	12.037	11.639	0.398
602	10.178	9.635	0.543	11.172	10.675	0.497	12.037	11.633	0.404
603	10.203	9.721	0.482	11.089	10.763	0.326	11.977	11.734	0.243
701	10.239	9.821	0.418	11.048	10.855	0.193	11.957	11.832	0.125
702	10.219	9.767	0.452	11.069	10.806	0.263	11.967	11.783	0.184
703	10.221	9.768	0.453	10.994	10.809	0.185	11.901	11.788	0.113
704	10.609	10.605	0.004	11.032	10.966	0.066	11.945	11.794	0.151
801	10.275	9.920	0.355	11.150	10.955	0.195	12.061	11.918	0.143
802	10.303	9.973	0.330	11.135	11.009	0.126	12.065	11.972	0.093
803	10.276	9.908	0.368	11.099	10.944	0.155	12.021	11.916	0.105
804	10.252	9.859	0.393	11.085	10.893	0.192	11.994	11.866	0.128
901	10.334	10.052	0.282	11.183	11.075	0.108	12.111	12.019	0.092
902	10.955	10.667	0.288	11.686	11.483	0.203	12.207	12.157	0.050
903	10.759	10.585	0.174	11.558	11.438	0.120	12.197	12.148	0.049
904	10.589	10.505	0.084	11.419	11.389	0.030	12.162	12.130	0.032
905	10.460	10.360	0.100	11.284	11.292	-0.008	12.152	12.115	0.037
906	10.335	10.052	0.283	11.171	11.075	0.096	12.112	12.028	0.084